A continual stream of reports, wires and letters from everywhere has been our lot since the Wage-Hour Act was ruled to apply to the telephone industry. The Wage-Hour Committee of the National Association get our flowers for the month for their accomplishments and labor in presenting the case of telephony before the assembled Congress at Washington. Late news reports are on pages 13 and 18.

▼

The Wage-Hour question will be the main topic at the State Association conventions that started late in January with the Minnesota meeting. We hope to discuss the matter personally with those attending the Texas and Oklahoma conventions next month. Make arrangements now to attend your state convention as you are faced with a crisis that needs your immediate attention.

▼

In this issue we present a writer new to our readers. We refer to Imre Molnar, and his article "Dry Discs in Telephony." We will wait for opinions after reading—personally we think we have discovered someone.

TELEPHONE ENGINEER

MANAGEMENT • ENGINEERING • MAINTENANCE

Vol. 43, No. 2 **February, 1939**

CONTENTS

- Across the Editor's Desk..... 10
- "Tapping In" on Washington By Roland C. Davies..... 13
- Safe Pole Handling By Ray Blain, A.I.E.E..... 15
- Dry Discs in Telephony By Emre Molnar..... 17
- Convention Schedule..... 18
- Editorial—Amendments to Wage-Hour Act..... 19
- Short Course in Telephone Transmission The Decibel (DB) Part II By B. C. Burden..... 20
- Ohio Association Favors Lorain Company..... 21
- Death Takes Ben Woodbury..... 26
- Telephone Patents Studied by Anti-Monopoly.—By Roland C. Davies..... 28
- Line & Desk—By Ray Blain..... 30
- Long Lines—By R. A. Clark, Jr..... 32
- These Tickled Us—By J. A. Smith..... 35
- Index to Advertisers..... 42

Published Monthly by

Telephone Engineer Publishing Company

A Magazine devoted to the interests of the entire telephone industry—operating men and manufacturers.

SERVING THE FIVE BILLION DOLLAR TELEPHONE INDUSTRY

Founded in 1909

Office of Publication, Pontiac, Illinois. Executive and Editorial Offices 185 N. Wabash, Chicago, Illinois. Phone Franklin 4094. J. A. SMITH, President and Treasurer; RAY W. SMITH Vice-President and Editor; L. M. BERRY, Vice-President; D. WEINER, Secretary Subscriptions: U. S., Cuba, Mexico, $1.00 Per Year; Canada, $1.50; In all Other Countries, $3.00. Single Copies, U. S. A., 15 cents.

A continual stream of reports, wires and letters from everywhere has been our lot since the Wage-Hour Act was ruled to apply to the telephone industry. The Wage-Hour Committee of the National Association get our flowers for the month for their accomplishments and labor in presenting the case of telephony before the assembled Congress at Washington. Late news reports are on pages 13 and 18.

▼

The Wage-Hour question will be the main topic at the State Association conventions that started late in January with the Minnesota meeting. We hope to discuss the matter personally with those attending the Texas and Oklahoma conventions next month. Make arrangements now to attend your state convention as you are faced with a crisis that needs your immediate attention.

▼

In this issue we present a writer new to our readers. We refer to Imre Molnar, and his article "Dry Discs in Telephony." We will wait for opinions after reading—personally we think we have discovered someone.

TELEPHONE ENGINEER

MANAGEMENT • ENGINEERING • MAINTENANCE

Vol. 43, No. 2 **February, 1939**

CONTENTS

- Across the Editor's Desk..... 10
- "Tapping In" on Washington By Roland C. Davies..... 13
- Safe Pole Handling By Ray Blain, A.I.E.E..... 15
- Dry Discs in Telephony By Emre Molnar..... 17
- Convention Schedule..... 18
- Editorial—Amendments to Wage-Hour Act..... 19
- Short Course in Telephone Transmission The Decibel (DB) Part II By B. C. Burden..... 20
- Ohio Association Favors Lorain Company..... 21
- Death Takes Ben Woodbury..... 26
- Telephone Patents Studied by Anti-Monopoly.—By Roland C. Davies..... 28
- Line & Desk—By Ray Blain..... 30
- Long Lines—By R. A. Clark, Jr..... 32
- These Tickled Us—By J. A. Smith..... 35
- Index to Advertisers..... 42

Published Monthly by

Telephone Engineer Publishing Company

A Magazine devoted to the interests of the entire telephone industry—operating men and manufacturers.

SERVING THE FIVE BILLION DOLLAR TELEPHONE INDUSTRY

Founded in 1909

Office of Publication, Pontiac, Illinois. Executive and Editorial Offices 185 N. Wabash, Chicago, Illinois. Phone Franklin 4094. J. A. SMITH, President and Treasurer; RAY W. SMITH Vice-President and Editor; L. M. BERRY, Vice-President; D. WEINER, Secretary Subscriptions: U. S., Cuba, Mexico, $1.00 Per Year; Canada, $1.50; In all Other Countries, $3.00. Single Copies, U. S. A., 15 cents.

TELEPHONE ENGINEER
MANAGEMENT - ENGINEERING - MAINTENANCE

FEBRUARY, 1939

"Tapping In" On Washington

By ROLAND C. DAVIES
Editor
Telecommunications Reports

CONGRESS is slated to launch a study during the latter part of February and early March into two questions which are highly important to the telephone industry—the plan of President Roosevelt and Chairman McNinch for a sweeping shakeup of the Federal Communications Commission and **the proposed legislation to exempt telephone operators in exchanges of 1,000 subscribers or less, which would comprise the small cities and towns and rural sections, from the Wages-Hours Act.**

While the developments of both these proposals are far from any final stage of action—especially the FCC reorganization plan—, hearings are expected to be held on both issues before important Senate committees which will be affairs of major interest for the telephone industry. The Senate Interstate Commerce Committee will probe into the project for the "ripper" elimination of the present seven-member FCC and the creation of a new Federal Communications and Radio Commission to be composed of only three Commissioners. On the proposal to exempt telephone operators in the exchanges of 1,000 subscribers or less, the Senate Education and Labor Committee will inaugurate hearings on or about March 9th at which the telephone industry can present to Congress the burden upon the smaller exchanges in the telephone field of the Wages-Hours Act, especially the provision of a 44-hour maximum work week, due to the static condition of the rates and revenues of the service. Two House bills, calling for this exemption, and another measure, which would exempt all telephone companies like the street car and motor bus services from the Fair Labor Standards Act (Wages-Hours), are also likely to be the subject of hearings before the House Labor Committee during March.

Wages-Hours Exemption Proposal of Immediate Interest

The subject of the status of the telephone industry, especially the Independent industry with its predominant field in the smaller cities and towns and rural areas of the country, under the Wages-Hours Law is the question that holds the most pressing and immediate interest. As the result of a presentation of the status of the telephone industry with its rates regulated by state commissions so that its revenues were of a fixed or static character by the Wages-Hours committee of the United States Independent Telephone Association over a period of several weeks to leading members of Congress and to the chief officials of the Wages-Hours Administration, the bills to exempt the industry's operators in the 1,000 subscriber-or-less exchanges were introduced in Congress during the first week of February.

THE proposed exemption for the telephone industry marked the first major step in Congress to revise the Fair Labor Standards Act since the Wages-Hours law went into effect last October 24. The situation of the exchanges in the small and middle-sized cities and towns and rural areas with their rates frozen by regulation under the increased burden of expenses, due to the maximum hours of work requirement mainly as the wages in the industry are generally in compliance with the Wages-Hours Law, attracted the interest of leading Senators and Congressmen. Instead of viewing with a jaundiced eye the plea of the telephone industry for relief from the Wages-Hours provisions as Congress was disposed to do during the passage of that law, the Senate and House leaders evinced a sincere willingness to study the problem with hearings.

On the Senate side, Senator Herring, Democrat, of Iowa sponsored the exemption bill because the Independent industry has its greatest development in his state. In the House Representatives Harrington of Iowa and Representative Romjue of Missouri, both Democrats, offered the 1,000 subscriber or less exchange measure, while Representative Chapman, Democrat, Kentucky, proposed in a bill the complete exemption of the industry.

Because of the keen interest by members of Congress in the problem, the United States Independent Telephone Association Wages-Hours Committee in their conference in Washington received many requests for complete information about the effect of the Wages-Hours provisions on the telephone service, especially in the smaller communities. As a result the Wages-Hours Com-

mittee of the National Association is urging every independent telephone company to support the Senate and House bills by writing the Senators and Representatives of their states and furnishing them with the picture of the industry's situation, particularly the effect of the increased payroll expenses on telephone service and whether or not service might not have to be curtailed or even suspended.

THE proposed exemption of operators in exchanges of 1,000 subscribers or less would relieve approximately 11,000 of the 12,000 exchanges of the Independent industry and several thousand exchanges of the approximately 6,000 Bell System exchanges. The bills introduced by Senator Herring and Reps. Harrington and Romjue would add a new subsection 11 under the general exemption clause Section 13(a) of the Fair Labor Standards Act naming for exemption "operators employed in telephone exchanges having one thousand subscribers or less." The Chapman measure would include the words "telephone exchanges" in subsection 9 of Section 13 (a) which exempts street car and trolley companies and motor bus lines. The U. S. Independent Telephone Association committee on Wages-Hours is headed by John H. Agee, former association national president and executive vice president of the Lincoln, Nebr., Telephone and Telegraph Co.

Plan for New "Federal Communications and Radio Commission"

In a sensational surprise move that came like a thunderbolt out of the clear sky, President Roosevelt and FCC Chairman Frank R. McNinch proposed to Congress a drastic "ripper" reorganization plan for the much-battered Federal Communications Commission—a move which projects the reduction of the present seven-member agency to a three-man Board.

AFTER a series of conferences for a week, the FCC Reorganization plan was drafted into a bill by Chairman McNinch and his aides and was introduced to Congress with Chairman Wheeler of the powerful Senate Interstate Commerce Committee sponsoring the measure. On the House side, however, Chairman Lea of the House Interstate Commerce Committee who was asked to present a similar bill wanted to study the proposal further—undoubtedly to await Congressional reaction to the plan because of the important implications of concentrating Administration control of the valuable political campaign weapon of radio broadcasting. While Senator Wheeler asserted that his committee would engage promptly in hearings on the Reorganization measure, the House Interstate Commerce Committee chief definitely precluded any hearings by his body until April because his committee is now working full tilt on the railroad relief legislation.

THE FCC Reorganization plan looms as a "battle royal" in Congress and the speculation is that there are many obstacles in its path so that many observers feel there will be no Congressional enactment at this session and, due to the present strife within the Democratic party between the New Deal and anti-New Deal adherents, there is a growing belief that nothing can happen to overturn the present makeup of the Commission until after the 1940 campaign. In fact, the tide now seems to be running that instead of the President's program for a reorganization of the FCC into a new agency Congress may use the Presidential proposal as a "springboard" to launch the often-threatened investigation on Capitol Hill of the FCC and its regulation of communications and radio broadcasting.

The bill to revamp the FCC, besides establishing a three-man Board, sets up a new system of administering the regulation of communications and radio which holds important aspects for the telephone industry. It provides that three Administrative Assistants, who will have power to act on all matters, except those requiring the quasi-judicial decisions of the Commission, will be established—one to handle radio broadcasting; another for Telephone and Telegraph Domestic Communications and a third for International Radio and International Communications. Another innovation will be the establishment of a new Research and Information Department which will engage in research of telephone regulation, probably along the lines of the former Rate and Research Department of the FCC Telephone Investigation, and will handle and act on all complaints by telephone users. The three Administrative Assistants are slated to have far greater authority than the former Directors of Divisions—they not only will receive $9,000 a year salary in place of the Directors' $7,500, but also will be designated with executive powers and will be directly under the supervision of the Commission Chairman.

"THAT'S THE P.B.X. ORDER THAT GOT AWAY."

Factors of Opposition in Congress to FCC Shakeup

There are a number of important factors of controversy which will undoubtedly

SAFE Pole Handling

By
RAY BLAIN

MODERN machinery has in recent years removed much of the *danger* and drudgery from pole handling on telephone work. This has resulted in *fewer accidents* although serious injuries to workmen do still occur entirely too frequently. Perhaps the most dangerous feature of all pole handling is the one which has remained with us down through the years, *that of unloading poles from flatcars.*

The modern line construction truck with the pole derrick which may of course be used to unload poles from cars though this is an extremely slow method and seldom used in this modern age of speed. A gin pole may also be erected near a carload of poles and used for unloading a few at a time though this is likewise a slow process and not without danger. Practically all telephone companies now use an elevated rack for the storage of their poles in the yard. This rack makes use of short lengths of poles set into the ground and with crossmembers of either pole or steel railroad rails. This rack supports the poles two or three feet above the ground and when so stored they are generally considered safe for extended periods.

When a full carload of poles has been received and spotted in the yard, skids made from small poles are generally placed to transfer the load from the car to the storage rack. The wooden stakes on the unloading side of the car, except the two ends are removed and rope slings placed in position and snubbed tight to catch the poles and hold them on the skids when the two end standards of the car are chopped off with an axe. The chopping of these standards and dropping the pole load to the skids and into the slings is a moment of real danger and where workmen are often seriously injured.

NUMEROUS other rope sling methods are used to accomplish this bulk unloading though all are somewhat similar and equally dangerous. Some merely cut the standards which permits the poles to roll down the skids and onto the rack in a heap without any attempt at the use of rope slings. This is also dangerous and generally causes considerable breakage of small poles. We would not in general recommend any of the forgoing methods now that a much better and safer method is available.

The usual method of binding pole loads on flat cars is to lash the standards together across the poles with several strands of wire twisted together. These ties often break or loosen in transit causing the poles to shift on the car, or cars if they are extra long poles. Recently the elimination of this difficulty has been made possible by the proper use of flat steel bands as load binders. These binders, in a smaller size, are used in lieu of the wire strands to lash the car stakes across the top of load. Larger bands are also used by placing them entirely around the pole load in several places to bind them firmly and practically eliminate all possible shifting while in transit.

Various types of steel bands are now available for this purpose. Ordinarily they range in width from ¾″ to 2″ and are from .035 to .050 in thickness and have an ultimate tensile strength in pounds from 2,400 to 10,500. The customary practice is to use the 2″ steel bands for binding around the pole load and the ¾″ size to bind the top of the standards together over the load.

TO INSTALL, the straps are merely wrapped around the load and both ends inserted into a small hand machine and lever action draws them as taut as desired. The ends are then locked together in a manner which makes the point of sealing practically as strong as the band itself. When workmen become familiar with the operation and handling of these machines the bands are easily and quickly applied.

Those who have read thus far may now wonder how this method of pole

1. Placing special skid in pocket or loop on car.

2. Cutting the steel bands after the skids have been pulled in place against the poles and the lines

3. Cutting the large bands which circle the pole load. All workmen should keep clear of the unloading side while this is being done.

4. Slowly lowering the steel skids while easing the tension on the snubbed lines.

5. (Below) The skids lowered and the poles may now be rolled slowly from the car.

Practical application on shipment in transit to insure safety and safe delivery.

binding could possibly be of any benefit to the telephone industry. The principle advantage in its use from a telephone standpoint is that it provides an easy, *safe* and rapid means of unloading full carloads of poles of either the large or small variety. The only special tools necessary for the successful use of this method is a pair of special hinged steel skids. The hinge is just above the stake pocket of the flatcar when the skid is in position. They may be purchased at a small cost or may be constructed by almost any blacksmith from short lengths of discarded 100 pound railroad steel rails. A clevice arrangement should be placed on the end of the skid for attaching lines.

● The railroad tracks should be practically level at the point where the car is unloaded. The hand brake should be set and the wheels securely blocked. As an extra precaution and in the interest of safety we suggest that two of the standards be removed from the unloading side of the car and be placed temporarily in two vacant stake pockets on the opposite side. The special steel skids should now be placed in two vacant pockets on the unloading side. These skids should be placed in a position so located that they may handle the entire pole load without difficulty or unbalance which might cause slipping.

STRONG rope lines or wire cables should now be attached to the clevice arrangement at the ends of the steel skids and passed over the top of the pole load to the opposite side of the car. These lines should now be used to pull the skids up and in a position parallel with the stakes on the side of the car. Strong timbers, ordinarily some of the wood standards should be placed in the car trucks and the lines snubbed around them and the car couplings. When the ropes are all tight and securely snubbed the skids should be resting firmly against the pole load.

The small bands which are used to bind the top of the car standards together may now be cut with a special shear. The standards on the unloading side of the car should now be removed. All workmen should get clear of the unloading side and the remaining 2″ steel bands which are cinched around the pole load may all be cut loose. Tension on the lines should now be slowly and carefully eased off and the hinged rails lowered until the ends touch the ground or pole rack. Care should be taken to lower the skids absolutely together to prevent the pole load from cocking in the air or slipping to either side. When the skids have been lowered the lines may be slacked off and removed entirely. The poles may now all be rolled easily down the skids to the ground or onto the pole rack for storage.

This method of pole handling is so convenient safe and easy that in our opinion no telephone company can well afford to be without its numerous advantages. Pole users have voiced an interest in this method and when ordering poles in car load lots we suggest that you specify and insist that they be loaded in this manner in order that you may take advantage of this modern unloading method. It is my understanding that the cost of using the flat seel band method is equal or less than the conventional method of bracing poles.

THESE steel load bands will be found extremely useful for many other purposes around any telephone exchange. They may be used to advantage in attaching lagging to cable reels. When nails are used for this purpose they are not only slow but soon cause considerable damage to the reel itself. Lagging should always be replaced on reels until all cable has been used from them to prevent damage to the lead sheath. The steel bands will also be found most useful for bundling the lagging for return to the supplier after all the cable has been removed from the reel.

The steel bands will also be found extremely useful for binding any small articles in bundles for greater convenience in handling. Some manufacturers now make use of it to brace clay conduit tile while in transit to prevent loss from breakage. It is also useful in binding pole and crossarm loads on trucks and trailers. The steel band is attached so much quicker than ropes and chains and holds so much better that no comparison may be made between the two methods. In fact the uses for this product are so numerous that we feel an outfit would pay for itself in any telephone exchange in a very short period of time.

The steel band comes in ribbon wound coils weighing about 80 pounds. Special coil holders are provided to keep the band from tangling and provide a means of paying it out easily in any length. One type of coil holder and truer is adjustable for all sizes of band and is equipped with a compartment for tools, seals, etc. This coil holder may be used as a stationery unit and purchased without truck. The special tool consists of a band stretcher, band sealer and special shears. These tools are sturdily constructed of steel castings and tool steels, cadium plated to prevent rust. With ordinary care they will last a life time. We urgently suggest that all telephone people investigate the possibilities of this new product. The editor will do doubt be glad to give you further details if you will address him.

While stretching tool remains in position the bands are quickly sealed.

By IMRE MOLNAR, Dipl. Ing. (Berlin)

Dry Disc Units In Telephony

Figure 1

The significant qualities of copper discs coated with cuprous oxide: (1) Unidirectional conductivity and (2) Nonlinearity of their resistance, make them valuable and convenient in electrical circuit design. Some general data and few represetative applications in telephone circuits are summed up below.

FOR MANY years it was known that certain combinations of certain metals and metal compounds will conduct electricity in varying degrees depending upon the polarity of the applied electrical potential. As far back as 1874 the oxide of copper was known to possess rectifying properties. During the study of photoelectric phenomena in 1920, it was definitely established that if copper is coated with a layer of cuprous oxide (Cu_2O) and current is passed through the oxide at right angles to the separating surface, the resistance was less when the current flowed from the oxide to the copper than in the reverse direction. To date, there has been no generally accepted explanation. According to one theory, electrons can pass from copper into the oxide even without application of external E.M.F. due to their close affinity. All this happens in the junction layer between copper and oxide and the resistance in that direction is small owing to the fineness of this layer, to the large surface area and to the dielectric constant of the oxide. Due to the electron concentration near the surface of the copper, however, high resistance is offered to the electrons being driven from the oxide into the copper by an external potential, applied in the reverse direction.

The fundamental part of a rectifier consists of a copper disc obtained from specially selected and rolled material. The discs are heated to a very high temperature and then quenched in water. Both heating and cooling is done gradually. By this treatment the copper is covered with two thin oxide layers: The inner one, as the actual rectifying agent, of red cuprous oxide, and an outer crust of black cupric oxide (CuO) subsequently removed from the disc. The whole process must be very closely supervised and frequent spot checks of the electrical resistance made, since the slightest irregularity renders the disc unsuitable as rectifier elements. Contact with the oxide surface is made by a lead washer, and copper discs and washers are piled up over an insulated spindle alternately, and the whole assembly is tightened under prescribed pressure.

FROM Figs. 2 and 3 the rectification does not appear to be absolute, i.e., when the voltage in the reverse direction is being reduced toward 0, the resistance of the unit becomes smaller. The reduction of the resistance continues beyond the 0 axis into the forward direction until at about 0.8 volts a steady resistance value is reached. From there on the voltage-current characteristic of the unit is almost linear. Considering this, at least 0.8 volt drop per unit under actual circuit condition would be desirable, but due to other factors, this value in most cases cannot be obtained. The six and twelve disc units, 3½" diameter, as frequently used in telephone circuits, have 2.1 and 4.0 volt drop respectively, when new, and 3.9 and 7.2 volts, when aged, at their continuous current rating. For intermittent operation these values can be exceeded, being limited only by current carrying capacity of the units. For the reverse direction it is customary to specify 3 volts per disc for continuous operation, although it will safely withstand 30 volts for one second. The puncture voltage of the oxide film at normal temperature is between 50 and 100. The voltage-current characteristic

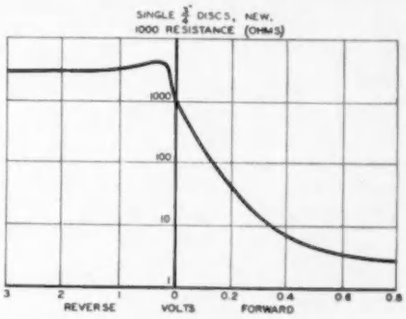


Figure 3

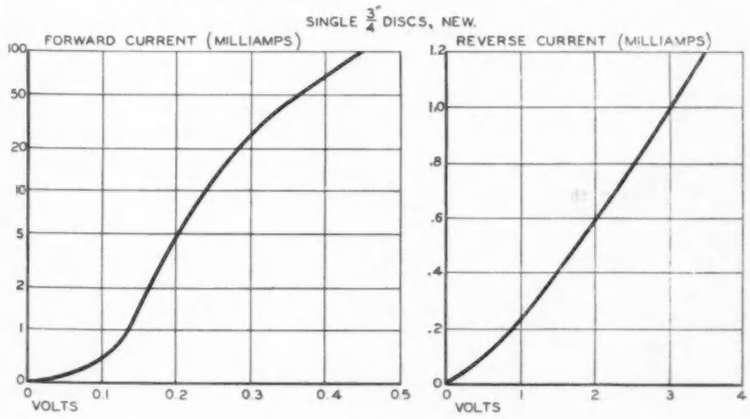


Figure 2

of the unit in the reverse direction is not linear, but since the resistance in that case is several thousands times as great as that in the forward direction, a constant reverse impedance is not essential.

In the design of circuits where rectifiers have to carry current over a period, the heat dissipation represents the major problem. A rectifier which would have 2 volts drop per disc carrying 0.5 amperes should dissipate 1 watt per disc. Since the electrical resistance is concentrated within the thin oxide coating, any excessive temperature will influence the electronic property of this layer. A change from 35 degrees centigrade to 60 degrees centigrade will reduce the resistance in both directions by almost 50 percent. Above 60 degrees centigrade the forward resistance increases and the rectifying capability becomes permanently reduced. On account of the tight assembly units under constant current are rated at 0.1 watt per square inch, but with additional cooling fins it is possible to obtain as much as 1 watt dissipation. For operations of less than 1 second duration the above values can be increased approximately 50 times.

DURING the first six months of operation, rectifier units increase their resistance in the forward and decrease it slightly in the reverse direction. This change happens regardless of whether the rectifiers are in actual use or not. The rate of change, however, is faster in the former case and increases with the temperature at which the rectifier is working. For units under constant load and high temperature, the resistance increase may amount to as much as 100 percent. For units in intermittent service, as in the case in the below mentioned examples, the resistance increase would amount to not more than 25 percent. Considering the usual external circuit resistances, such a change is usually negligible. Slightly more important is the change in reverse current, which may increase to 2-3 milliamperes with ¾" units and must be considered in circuit design. After approximately 6 months the ageing is completed and the resistance approaches a steady value. Ageing is partly caused by the natural slackening of the pressure and oxidation between lead and oxide; and partly by the natural easing of tension and rearrangement of crystals in the junction film between copper and oxide.

Typical test requirements of 1½" units are as follows: At 1¼ amperes at normal temperature, the impedance per disc must be between ½-1 ohms; when 1½ volts per disc are applied the current in forward direction must be minimum 0.5 amperes, and in reverse direction maximum 0.5 milliamperes.

Convention Schedule

Texas Telephone Association, Baker Hotel, Dallas, March 22, 23 and 24.

Oklahoma Telephone Association, Huckins Hotel, Oklahoma City, March 27 and 28.

Kansas Telephone Association, Municipal Auditorium, Junction City, March 30 and 31.

Missouri Telephone Association, Hotel Muehlebach, Kansas City, April 3 and 4.

Nebraska Telephone Association, Lincoln Hotel, Lincoln, April 11 and 12.

Iowa Independent Telephone Association, Fort Des Moines Hotel, Des Moines, April 18, 19 and 20.

Ohio Independent Telephone Association, Deshler-Wallick Hotel, Columbus, April 25 and 26.

Indiana Telephone Association, Claypool Hotel, Indianapolis, May 10 and 11.

Pennsylvania Independent Telephone Association, Yorktowne Hotel, York, May 18, 19 and 20.

New York State Telephone Association, Hotel Syracuse, Syracuse, May 23, 24, 25 and 26.

The Illinois Telephone Association, Pere-Marquette Hotel, Peoria, June 7 and 8.

Wisconsin State Telephone Association and Wisconsin Locally Owned Telephone Group. Park Hotel, Madison, June 13-15.

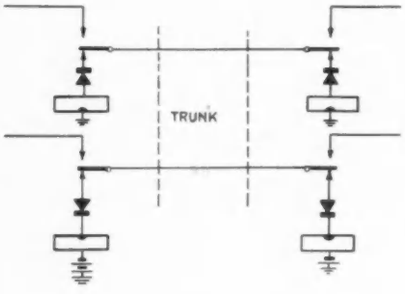


Figure 4

Beside the cuprous oxide units another type of rectifier has received attention. A 0.05 millimeter selenium coating is applied between an iron disc and a soft metallic layer. The conducting direction is from selenium to the soft layer. The actual rectifying agent is a 0.00001 millimeter film between the two layers. The recommended reverse voltage per unit is 18 volts, reducing the number of discs to 1/6 of what is required for copper oxide. Since the units may be operated at 75 degrees centigrade, the permissible current density is 300 milliamperes or 0.3 watts per square inch. Selenium rectifiers are expensive and have not been used a great deal in this country.

COPPER oxide units possess two important properties: their resistance is practically unidirectional, and their forward resistance decreases with increasing voltage applied to them. Both have been utilized in telephone circuit design. The first property is exploited in two ways: preventing direct current of unwanted direction to enter a circuit (polarizer), and converting alternating current into unidirectional current (rectifier). The second property has many applications where non-linear impedances are required. A few examples selected from the above three groups are described forthwith.

An ordinary D.C. relay can be polarized by shunting it with a copper oxide unit or connecting one in series with it. In both cases, the resistance of the unit must be considered in the circuit design. In the series case, $E=I(R+S)$, where R is the resistance in series with the unit and S the resistance of the unit at the voltage drop (E—IR). In first approximation a tentative value for S should be inserted in the equation, then I calculated and a new value for S determined from curves similar to Figure 3. By "cut and try" method, the actual current can be arrived at. In the shunt case, if Z is the external resistance, R the relay resistance and E the voltage of the power supply, the current through the relay is determined as $E\frac{S}{RZ+RS+ZS}$; where S is the copper oxide resistance at $E\frac{RS}{RZ+RS+ZS}$ volts.

IN message rate service the metering pulse is in some systems transmitted over the third conductor, which is otherwise used to mark free or busy condition of the line. If ground is placed on this lead to hold the subscribers' cut-off relay during conversation, the message register connected in multiple with the cut-off relay may be operated by a momentary positive pulse of an additional battery, which has its negative side grounded, and simultaneously removing ground from the third conductor. If the message register is grounded through a copper-oxide unit conducting from the meter to ground, it will operate only during application of the metering battery, and release afterward. Such an arrangement is suitable for repeated registering, as required for Time and Zone metering service.

(*Please turn to page 33*)

Editorial

Amendment to Wage-Hour Law Presented

When Administrator Andrews of the Fair Labor Standards Act of 1938 (the Wage-Hour Law) made an interpretation of the Act to the effect that all telephone exchanges were subject to this law, telephone men were faced with: (1) a law that meant virtually "sudden death" to many telephone exchanges, and (2) the necessity of a UNITED front to combat this opinion and to temper the legislation whereby it might be fair and just to telephone companies and to the public.

Statistics show the first mentioned is true. If your exchange is of 1000 subscribers or less the application of the Wage-Hour Act means that your exchange would furnish insufficient funds to pay salaries, or else earnings would be so nearly depleted as to leave you in serious difficulty.

The second part was answered by the United States Independent Telephone Association and its Wage-Hour Committee. Although contending that telephone companies are service establishments, and therefore exempt from the law, they were ready to act when the Administrator ruled against this interpretation by the Committee.

The Association's immediate action in going to the nation's capitol in Washington to take up the fight for the existence of the smaller companies had some results. To actually succeed they need YOUR cooperation and ACTION—RIGHT NOW! Your efforts at this time might mean the difference between success and failure.

Since the Wage-Hour Committee has been in Washington there have been a total of six bills introduced in the Congress in the shape of Amendments to the Wage-Hour Act. Some of them seem good while others are entirely inadequate. In checking these bills it is the combined opinion of the Wage-Hour Committee that the industry should favor certain of the bills that have been offered and we are reproducing herewith the House Bill and the Senate Bill that seem most fair and workable. When you write your Congressman and Senators of the impossibility to exist under the law as it now stands you should also tell them that these bills will be satisfactory if enacted as they stand.

76th CONGRESS
1st Session
H. R. 3842

IN THE HOUSE OF REPRESENTATIVES
February 7, 1939
Mr. Harrington (Iowa) introduced the following bill; which was referred to the Committee on Labor

A BILL

To amend section 13 (a) of the Act approved June 25, 1938 (52 Stat. 1069), entitled "Fair Labor Standards Act of 1938."

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 13 (a) of the Act approved June 25, 1938 (52 Stat. 1069), entitled the "Fair Labor Standards Act of 1938", be, and the same is hereby, amended by adding a new subsection 11 as follows: "or (11) operators employed in telephone exchanges having one thousand subscribers or less".

76th CONGRESS
1st Session
S. 1234

IN THE SENATE OF THE UNITED STATES
February 9, 1939
Mr. Herring (Iowa) introduced the following bill; which was read twice and referred to the Committee on Education and Labor

A BILL

To amend section 13 (a) of the Act approved June 25, 1938, (52 Stat. 1069), entitled "Fair Labor Standards Act of 1938."

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 13 (a) of the Act approved June 25, 1938 (52 Stat. 1069), entitled the "Fair Labor Standards Act of 1938", be, and the same is hereby, amended by adding a new subsection 11 as follows: "or (11) operators employed in telephone exchanges having one thousand subscribers or less".

It is to be remembered that your committee serving you in Washington are devoting their time and efforts that the smaller companies might survive. They are on the ground. They must have the combined support of the entire industry in acquainting the Congress of the serious financial condition the Wage-Hour Act has caused our industry.

The National Association has provided the united front—your active assistance NOW is needed to carry through. Write your Senators and Congressmen!

(For further Wage-Hour Act developments see pages 13-14)

Short Course in Telephone Transmission

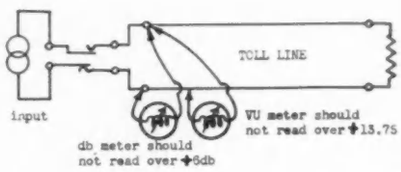


Fig. 11—Illustration showing difference between DB and VU as used to express the maximum power level that should be applied to any toll line.

(CONTINUED)

IT will be noted that the power input in the above equation when used for expressing power levels in decibels, is taken as .006 watts. In other words to express power levels in terms of the decibel we merely take the ratio of the power level under consideration to reference power and apply in our regular equation. If the power level to be converted to decibels is less than .006 watts then the level will be negative and if above .006 watts it will be positive.

The dial of a typical power level meter used for indicating transmission level in radio, public address and telephone work is shown in fig. 7. It will be noted that zero level is shown near mid scale and readings above this point are positive and those below negative.

Other Zero Reference Levels

Unfortunately zero reference level is not always taken as .006 watts and for certain types of measurements some companies use either .001 or .01 watts as zero reference level. The advantage claimed for these other reference levels is the fact that they are somewhat easier to apply numerically than is .001 watts. In general however .006 watts is the accepted zero reference level.

Zero level was originally established at this value because the output of a typical common battery telephone (earlier types) was about .006 watts, and inasmuch as the decibel was designed primarily for use in the telephone field, it was natural that a zero reference level pertinent to the telephone field would be selected. Fig. 8 illustrates the general features of zero reference level.

At first thought it may not be apparent what advantage the use of a reference level offers in connection with power level computations. In other words why not quote power levels directly in watts rather than convert to decibels in terms of a zero reference level. The reason lies in the fact that the decibel being logarithmic it lends itself better to transmission problems involving the summation of power levels at several points along a circuit. It also permits power levels to be expressed in simple one or two digit numbers. For example if we have a telephone repeater whose output is .06 watts we can by the decibel-reference level method use the more convenient expression + 10 db. That is:

$$\text{db} = 10 \log \frac{.06}{.006} = 10 \text{ db}$$

Telephone Reference System

Telephone circuits both local and toll must be designed so that conversation can be carried on over the longest connection that might be established. If this is not done the transmission losses may be so great as to make it difficult if not impossible to carry on a satisfactory conversation.

In order to have some standard by which circuits could be rated to see if they will be satisfactory from a transmission standpoint, a *standard reference system* was established a number of years ago. This system consisted essentially of two 24 volt common battery telephones connected to each other by means of an adjustable artificial standard 19 gauge cable. Fig. 9 shows such a system.

Continued

Subject: The Decibel (db)

By B. C. BURDEN

The common battery telephones used in this standard reference system utilized transmitters and receivers which are somewhat less efficient than the best present day instruments. After the standard reference set was established numerous talking tests were made to determine the maximum amount of cable that could be cut in the circuit between the two instruments and still permit satisfactory conversation to be carried on. These tests showed that in general the maximum loss on a toll circuit should not exceed approximately 30 *miles of standard cable*, and 20 *miles of standard cable on local calls.* While the old mile of standard cable does not offer exactly the same attention as a circuit having a loss of one decibel, the actual difference between the two units is not great hence we can say that based on our reference system transmission standard are 30 db for toll and 20 db for local calls.

IT WILL be seen that a better grade of transmission is furnished by these standards on local than on toll calls. This is based on the thought that economic considerations require that the cost of toll circuits be kept to a minimum whereas with local circuits the higher grade of transmission can be provided without excessive cost.

It will be noted that the standard reference system just described is not a precise standard due to the fact that the actual level of a testers voice cannot be exactly fixed as to level. Recognizing this the *Bell Telephone Laboratories* established a new standard reference system which done away with the human element and which was therefore reproducible and accurate.

From a practical standpoint we will have little if any occasion to work with standard reference systems and need only fix in our minds the quantitative significance of an overall loss (maximum) of 20 db or 30 db (local and

toll) and the early reference system enables us to get this understanding as it deals with ordinary telephone elements with which we are familiar. Figure 10 illustrates how the maximum standard loss would look in terms of circuits other than 19 gauge cable.

New Volume Transmission Unit (VU)

WE have in the January issue as well as in the preceding paragraphs discussed the use of the decibel in connection with a fixed *reference level* to express the quantative value of the power at any point in a circuit. It was pointed out that some confusion resulted from the fact that several different values of power were being used as zero reference level.

Information has recently reached us that a new unit will shortly be announced which will be used in conjunction with the decibel for expressing power levels. This new unit is to be known as the *VU* (*volume unit*) and will accomplish exactly the same result *and in the same manner* as the former practice of expressing power levels in terms of some arbitrary zero reference level.

The new unit will however, by definition "tie down" the zero reference level to a fixed standard value, thus doing away with the uncertainty and confusion of the old method in which different companies had established different zero reference levels.

The new *VU* unit will express power levels in terms of a zero reference level of .001 watt (one milli-watt) and levels above this value will be designated plus (+) and those below as negative (—). The unit will have the same numerical ratio as the *db*, and will be used only when we wish to express power levels (volume level). It will not replace but only supplement the db.

Practical Illustration of Use of New Unit

To illustrate the difference between the new and old system of expressing power levels let us consider a practical example. (See Fig. 11.)

Assume we wish to express the maximum power level that should be fed into a toll line if crosstalk is to be avoided. Previously we would have said that this maximum limit should not exceed +6db. This expression is usually in terms of .006 watts (6.0 milli-watts) as zero level. Hence the actual power which good practice dictates as a maximum input level is .006×3.98=.0238 watts. (Note 3.98 is the power ratio for 6.0 db.)

NOW using the new unit we would say that the maximum level should not exceed +13.75 db. This value was arrived

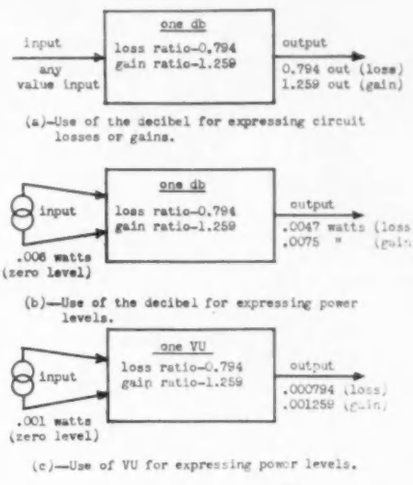


Fig. 12—Relationship between decibel (DB) and the volume unit (VU)

at by taking the ratio of the power which it is agreed should be the maximum fed into the ordinary toll line and the zero reference level specified for the new volume unit, i.e. .001 watt (one milli-watt.) The ratio of these two powers is

$$\frac{23.8\ \text{MW}}{1.0\ \text{MW}} \text{ or } 23.8.$$

Looking up a power ratio of 23.8 in a table of decibels VS power ratios shows that this corresponds to 13.75 db. But instead of referring to this level as 13.75 db, we say 13.75 *VU* (*volume units*) thus fixing definitely the zero level used.

From what has just been said it is apparent that power level meters previously calibrated in terms of the decibel will still read correctly on a volume unit basis where the calibration is in terms of .001 watts, but where it is in terms of .006 watts a correction factor will need to be applied.

Figure 12 illustrates the basic difference between the old and new methods of specifying power levels.

Decibel Tables

In transmission work we often have occasion to convert power, current, or voltage ratios to decibels, or vice versa. This can of course be done with the basic equations, viz:

$$(1)\quad \text{db} = 10 \log \frac{Po}{Pi} \quad \text{(power ratio)}$$

$$(2)\quad \text{db} = 20 \log \frac{E \text{ or } Io}{E \text{ or } Ii} \quad \text{(voltage or current)}$$

Many prefer to use conversion tables rather than the equations, as they are somewhat quicker and do not require any mathematical operation.

(In the March installment complete conversion tables will be included.)

R. H. Polk Dies

Atlanta, Ga., Jan. 5.—(Special)—R. H. Polk, 73 years old, former telephone executive and inventor of the "busy signal" for dial telephones, died here today. He had served as general manager of the Southern Bell Telephone company in Montgomery and Savannah.

Ohio Association Favors Lorain Company

In a meeting of the board of directors of the Ohio Independent Telephone Association held January 10th, unanimous resolutions were passed favoring the Lorain County Radio Corporation as their choice to handle all ship-to-shore communication for the navigable waters of the United States.

"The Radio Corporation of America, through one of its subsidiaries, proposes to construct a shore station near Cleveland, Ohio, and proposes to use all the radio channels now assigned to and being used by the Lorain station with the object and purpose of taking over as much as possible of the business which has been developed and built up by the Lorain company," according to the Resolution received in this office.

The resolution follows:

(a) That there is no public need for the proposed station;

(b) That the attempt to take over the business and radio channels used by the Lorain company is unjust and unfair;

(c) That the present company is the only such outlet and expression for the initiative and genius of Independent telephone engineers and technicians, and should be preserved for the public interest in the development of radio-telephony;

(d) That the Lorain company should be given a fair and reasonable chance to develop further its service and equipment before being subjected to destructive competition from a powerful competitor;

(e) That the Federal Communications Commission be respectfully requested to deny the said application as being unjust, unfair, and not in the public interest.

THE AUTOMATIC ELECTRIC RO

THIS "OPERATOR'S" VIEW GRAPHICALLY ILLUSTRATES THE TREM ADV
IN GREATER SIMPLICITY, INCREASED A

(Any position can be used for hand C. L. R

Coin Collect Key, collects on either front or rear of link circuit.

Line and Trunk Gr amps, indi origin of incoming

Line and Trunk Gr , indicate gaged line and trunk

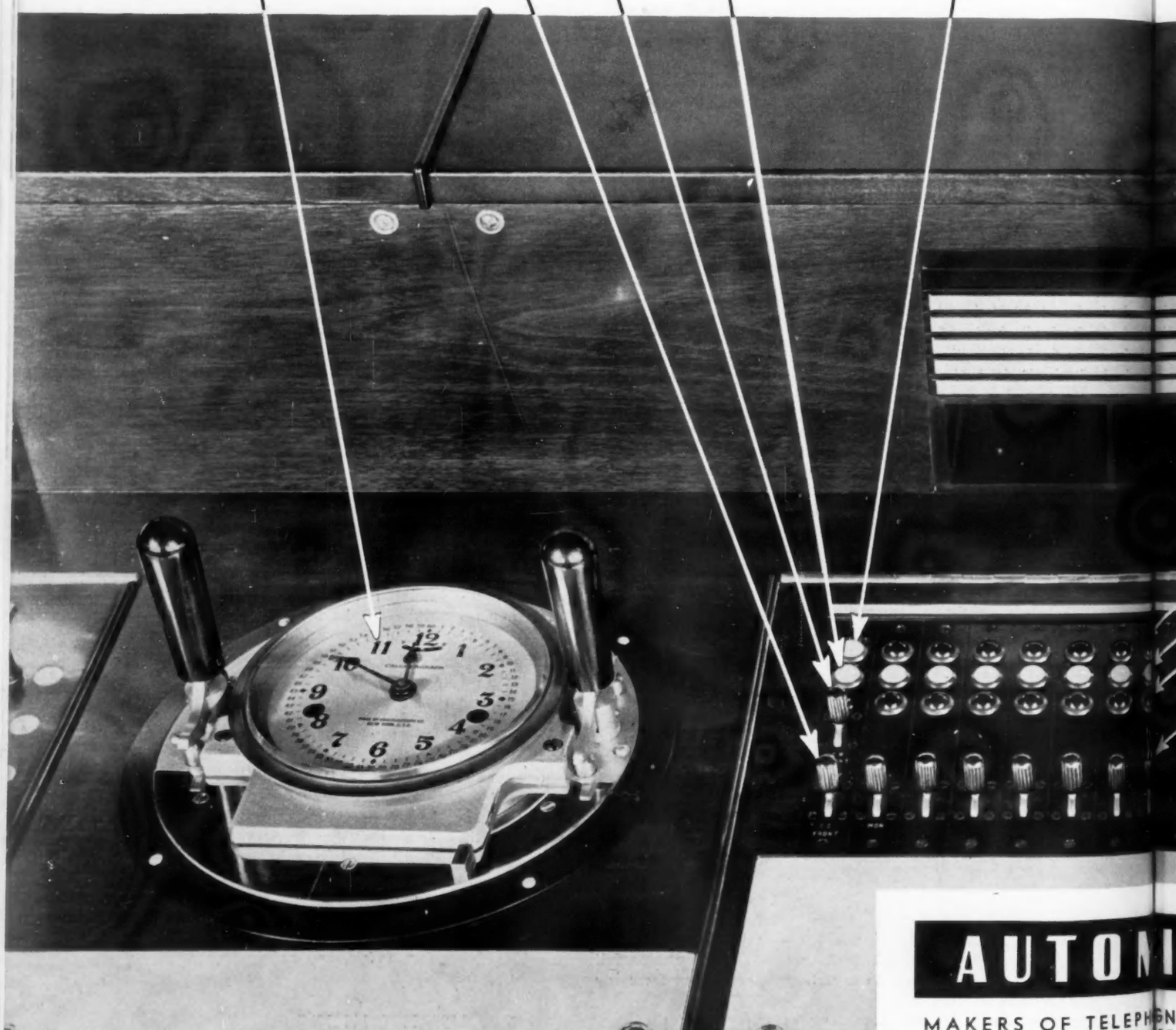
Coin Return Key, returns on either front or rear of link circuit.

Interposition Trunk Lamp, indicates call transferred from another position.

Standard Calculagraph, either spring or electrically operated, or electric automatic time stamp, can be supplied, as desired.

mmon Line ating Lamp ck Key to or trunk particular

Coin Supervisory Lamp, for indicating coin collect or return operation.



AUTONIC

MAKERS OF TELEPH GNALIN ELECTRICAL EERS

Distributors i

AMERICAN AUTO IC SALES C tors: Auton

ROTE CONTROL TOLL BOARD

TREM ADVANCE THIS "CORDLESS" AUTOMATIC TOLL BOARD MAKES NCREASED AND EASE OF OPERATION.

for hand C. L. R. and Delayed Call traffic.)

Trunk Gr amps, indicate incoming

Trunk Gr , indicate en- e and trun

mmon Line and Trunk In- ating Lamps, used with ck Key to show specific or trunk being used on particular call.

—Busy Lamp

—Rear Supervisory Lamp

—Front Supervisory Lamp

—Talk and Monitor Key

Position Circuit Keys and Lamps

Link Key and Lamps

Key Calling Device

Toll Answering Key, arranges position to answer incoming toll calls only.

Position Grouping Key

Delayed Call Key, arranges position to operate on a point-to-point or delayed call basis.

NIC AE SP ELECTRIC

EPH GNALING AND COMMUNICATIONS APPARATUS
AL EERS DESIGNERS AND CONSULTANTS

Distributors in U. S. and Possessions:
AUTO IC SALES COMPANY, 1033 West Van Buren Street, Chicago, U. S. A.
utors: Automatic Electric Sales Company, Limited

"Tapping In" on Washington

(Continued from page 14)

build up black clouds of opposition to the FCC reorganization scheme. First there is the fast-widening breach between Congress and the President. Because of this conflict within the Democratic party, Congress will be loath, it is believed, to hand over to the President a small, compact, easily-dominated and "rubber stamp" agency which would control the destinies of communications and, especially, broadcasting. The value of broadcasting as a medium of public opinion is too great for a Congress which has its eye cocked continually on the 1940 campaign, according to the present outlook, to grant the New Deal broad powers of control.

Because of this political atmosphere and also due to the many charges directed against the last Congresses of being too amenable to the Administration, the argument of the FCC Reorganization proponents to have a Commission which will be acquiescent in its actions and policies smacks of the "rubber stamp" accusation.

A most important factor is the furore that has arisen over the appointment by President Roosevelt of former Representative Amile of Wisconsin, a left-winger and outright advocate of government ownership, to the Interstate commerce Commission, the oldest and heretofore the most stable Federal regulatory agencies. Congress, for the most part, it is felt, would not wish to give the Chief Executive carte blanche to have three important posts like the new Communications and Radio Commission to fill with left wingers.

One uppermost question is how will the existing FCC operate while this storm of ripping it apart hangs over its head. The FCC is now working on the drafting of the Final Telephone Investigation Report. The division within the Commission is well known and pronounced in regard to the Proposed Report of Commissioner Walker and the ex-parte procedure of the Investigation. Chairman McNinch has indicated that a thoroughgoing study of every line of the Walker Report is now in progress, but the FCC Chairman has revealed that he has some rather concrete ideas of strengthening the telephone regulation which fall in line with the more stringent proposals of the Walker Report. However, other Commissioners, like Case and Craven, are opposed to the recommendations in the Walker Report which would give the Commission almost managerial responsibility over the Bell System through regulation of its policies.

The current guess is that a much modified and moderate-toned report will be the one transmitted to Congress than characterized the Walker Report. The Commission, it is expected, despite the storm over the Reorganization, will complete the Final Report during this session—unless the Investigation ex-parte procedure and the Proposed Report should be interjected as a major issue of any future Congressional Investigation of the FCC itself.

The FCC probably will rock along during the turbulent period without much action on controversial subjects which can direct the fire upon it from Congress. The gulf between the FCC membership is now so deep that the voting lines in the Commission of the group of Commissioners pro and against the McNinch leadership will be demarked in every action of significance. The Commissioners who are in disfavor—Commisisoners Craven and Payne and possibly Case—certainly will be ready to fight openly. Where the other three Commissioners, Sykes, Brown and Walker, will stand remains to be seen, but this trio previously has furnished the Chairman with his majority.

When the Senate Committee starts its hearings on the Reorganization bill, the real fireworks of the friction within the FCC will commence. All Commissioners will undoubtedly be given an opportunity to air their views and from the present outlook few "punches will be pulled. The recent radio broadcast of Chairman McNinch in which he assailed the Stanley High article on the Commission and its radio policies in the Saturday Evening Post contained a new high in the intra-FCC feud when the FCC chieftain directly accused Commissioner Payne of having given information to the Saturday Evening Post writer.

Wisconsin Commission Acts on Wage-Hour Exemption

After staff investigation and report the State Public Service Commission acted Feb. 15 to have smaller Wisconsin telephone exchanges exempted from the federal wages and hours act.

Staff investigation indicated that if the wages and hours provided in the federal act were applied many farmer telephone companies would be wiped out, rates in many cases would have to be doubled, there would be large reduction in use of telephone service particularly in smaller communities and rural areas, and many telephone operators might be thrown out of work by substitution of dial or other automatic service and through smaller telephone exchanges going out of business.

The Commission asked the federal wages and hours administration to exempt all telephone exchanges with less than 1,000 urban customers.

Small as well as large telephone exchanges in Wisconsin are subject to the wage and hour regulations of the Wisconsin industrial commission.

In a portion of an airmail letter which followed the telegram to the federal department the commission stated:

"Our experience has been that rural subscribers will not retain telephone service except at very low rates relative to urban rates and would not be willing to pay the rates necessary to meet the provisions of the act.

1940 Appropriation of FCC Held Up Pending Reorganization

In an unusual step, the House Appropriations Committee in the drafting of the Independent Offices Supply Bill left out any 1940 funds for the FCC "pending action" on the reorganization of the Commission. The Budget Bureau had allotted the FCC $2,038,175 for 1940, increasing the current funds which are $1,745,000. However, if the reorganization bill should be stymied in Congress, the 1940 appropriation can be included in a later deficiency bill.

The Telephone Investigation provided a feature of the hearings on the FCC Appropriation before the House Committee. The Republican members of the subcommittee which handled the Independent Offices Supply Bill—Representatives Wigglesworth of Massachusetts, Dirkson of Illinois and Case of South Dakota—pounded away at Chairman McNinch and Commissioner Paul A. Walker with questions about the ex-parte character of the Investigation and whether or not the Commission's Report to Congress could be fair and worthwhile based on such a record.

Chairman McNinch stressed that the FCC is carefully scrutinizing every line of the Walker Report and is rejecting every "unsupported fact." He declared that the Comments and Briefs of the American Telephone and Telegraph Co. critical of the Investigation and the Walker Report were now considered a part of the Investigation "record," but he agreed that this was not a full substitute for cross-examination and rebuttal testimony by the telephone company.

Commissioner Walker told the House Committee that the Investigation was

conducted as a legislative inquiry by Congress and that the facts in the exhibits were gleaned from the files of the A. T. & T. and Bell System companies. He pointed out that the Bell System would have its "day in court" before Congress and in cases before the state commissions. The Investigation was not a rate proceeding so that it did not need to conform to the rules of evidence and procedure laid down by the Supreme Court. Commissioner Walker stated that the Comments of the A. T. & T. which criticized the FCC Investigation exhibits were rejected because they did not conform to the ruling for correction of factual data only but were "argumentative."

The rate reductions which have ensued during and since the Investigation, Commissioner Walker said, have been directly or indirectly due to the disclosures in the FCC probe. He emphasized that the $12,000,000 long distance toll reduction in January, 1937, was brought about entirely by the Investigation.

The A. T. & T., according to Commissioner Walker, furnished five-eighths of the testimony through company witnesses who were advised in advance of the material which the FCC introduced into the record and more than 90 per cent of the material in the 77 Investigation staff reports came from the files of the company.

Commissioner Walker charged that the A. T. & T. was using the charge of ex-parte procedure as a main line of defense against the Investigation and the Proposed Report. He stated that the press had overplayed the ex-parte accusation "out of all proportion to its true importance."

In a memorandum given to the House Committee Commissioner Walker stated that the A. T. & T. "has complained in its briefs and in public statements" that the Proposed Report does not state the Bell System service is the best in the world. Such "purely self-serving and gratuitous" statements by the Bell System have been published widely by the press, Commissioner Walker said, and the wide publication "is a tribute to the effectiveness of the Bell System's vast propaganda machine." He declared that no studies were made during the Investigation comparing the service and rates of the Bell System with foreign countries and the FCC does not know whether the Bell System offers the best, most efficient or cheapest telephone service in the world. He cited that correspondence to the FCC indicated that long distance rates of the Bell System were considerably higher than similar charges in foreign countries, particularly England.

"The Proposed Report indicates," the memorandum of Commissioner Walker said, "that the Bell System Companies are inefficiently operated insofar as the cost of rendering telephone service is concerned. The type of service may or may not be the most efficient in the world, but the cost of rendering the same has been shown to be excessive."

FCC Hopes to Audit Accounts of Telephone Companies

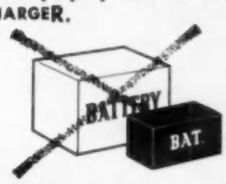
The FCC plans to embark on a program of auditing the accounts of telephone companies that ultimately would be nation-wide in coverage and would include a setting up of field offices in various sections of the country. The 1940 appropriation for the Commission, which was withheld in the Independent Offices Supply Bill in the House, proposes the establishment of at least one field office in addition to the present New York office FCC Chief Accountant Norfleet informed the House Appropriations Committee that this step was needed to ascertain whether the telephone companies are keeping their books in compliance with the FCC Uniform System of Accounts. He cited that under the present set-up of the Commission that that Agency is now only able to audit the accounts of the telephone companies in New York and Washington.

The new move which is projected by the FCC is highly significant due to the recent censure of the private auditing firms by the SEC in the disclosures arising out of the McKesson-Robbins drug firm expose, and by Senator Wheeler who accused the Price-Waterhouse accounting firm of withholding from investors important financial items in the case of the bankruptcy of the Missouri Pacific Railroad. Undoubtedly these attacks on private auditing firms which are supposed to give independent appraisals of the financial conditions of companies have stimulated quite intensively the desire of Government regulatory officials to have their agencies conduct comprehensive audits of the finances of the companies under their jurisdiction.

This will be an important course of future Federal Communications regulation for the telephone industry to observe. Another step that seems to be in the making is the probing of the cost of telephone equipment manufacturing and research which FCC Chairman McNinch observed before the House Appropriations Committee was a major task for that Commission. Chairman McNinch also viewed as important the regulation of contracts between the holding company and operating companies and he and Commissioner Walker indicated that this sub-

$ave

The saving in battery cost alone may pay for a Raytheon RECTICHARGER.



It permits the use of much smaller batteries and lengthens their life.

The RECTICHARGER is not to be confused with a battery charger. It is the new way of furnishing DC power.

It carries the normal load.

The only servicing required is the occasional addition of water to the battery to replace evaporation.

A RECTICHARGER with a small storage battery floating across its terminals makes a complete, automatic AC-DC telephone power unit. Its DC voltage is stabilized to ±2% at any output even although the AC varies from 95-130 volts. It uses lifetime, dry disc copper oxide rectifying units. There are no moving parts. For full details consult your usual source of telephone supplies or mail the coupon.

RAYTHEON MANUFACTURING CO.
134 WILLOW STREET, WALTHAM, MASS.

Please send Bulletin DL48-263-1 on RECTICHARGERS.

Signed .....

.....

ject would be a significant phase of the Final Telephone Investigation Report to Congress by the FCC.

Miscellaneous Events

Despite the storm of FCC reorganization and the attacks which have been centered on that Agency, the Senate confirmed without any debate the nomination of Commissioner Norman S. Case, Rhode Island Republican, who served as Governor of his state for three terms before his appointment on the Commission. Commissioner Case was re-appointed for the full seven year term. The fact that no discussion occurred on the Senate floor when his confirmation came up appeared to indicate that he had a good reputation in Congress and further it might be a sign that he may be selected as the Republican member of the new Commission, when and if Congress enacts the reorganization bill.

The end of the eleven-year controversy of the Oklahoma-Arkansas Telephone Company against the Southwestern Bell Telephone Company to force the latter to establish physical connections for toll service came with the recent decision of the FCC denying this plea on the ground that the re-establishment of this connection was not necessary or in the public interest. Commissioner Walker dissented in the case, holding that the 1928 severance of the physical connection by the Southwestern Bell was ruthless and unwarranted and because of that situatiton the Commission should make a continued probe of the question. The FCC majority nevertheless held that the Oklahoma-Arkansas Co. did not have a good plant for toll service and that there was no public need for transferring toll service from the present Southwestern Bell well-engineered wires to the other company's lines which were not adequate for dependable transmission. The majority opinion, too, cited that the financial reports of the Oklahoma-Arkansas Co. which showed an earning of 8% on its undepreciated plant evidenced the loss of the toll service did not injure its financial stability.

The radio telephone service to ships on the Great Lakes will be an important subject of inquiry at the Cleveland hearings to be conducted by Commissioner Brown March 6th. A highlight of this hearing will undoubtedly be the controversy between the Lorain Radio Corporation which is an affiliate of the Lorain Telephone Company and the Radiomarine Corporation of America. The Lorain Company, a leading Ohio independent telephone carrier, has developed in recent years a highly successful radio telephone service with Great Lakes shipping. The RMCA has recently applied for FCC approval of establishing a radio telephone station on the Lakes and this move is opposed by the Lorain Company. The Independent Telephone Association of Ohio has sent a protest to the FCC against the establishment of the RMCA station in competition with the service of the Lorain Company. (See page 21)

Death Takes Ben Woodbury

Ben Woodbury, Telephone Sales Manager of the Stromberg-Carlson Telephone Mfg. Co., died January 30th in Genesee Hospital, Rochester, N. Y., from injuries suffered in a traffic accident the previous Thursday. He was a member of the Independent Telephone Pioneers and the Telephone Pioneers of America.

Ben Woodbury

Mr. Woodbury left an enviable record of accomplishment. Notwithstanding the intenseness with which he devoted himself to his business, he found time to take interest in civic, fraternal and religious activities.

In the telephone industry, in which he spent the greater portion of his business life, his name ranked high. He leaves a host of friends among telephone people throughout the country including many young men who will long remember him for his encouragement and leadership under which they have grown. He started his career in Telephony with the Kellogg Switchboard and Supply Company, with whom he was associated for about 22 years. He made his way, in that time, from an apprentice in the shop to Vice-President and General Sales Manager of the company. On August 1st, 1927, he joined the Stromberg-Carlson Telephone Mfg. Co.

Born in Granville, Ohio, October 31, 1882, he received his formal schooling in the public schools of Columbus,

DUO-VOX RADIO-TELE-PHONO

TWO-WAY LOUD SPEAKING TELEPHONE SYSTEMS
available for every application including . . .
WET -- GASEOUS -- NOISY -- HAZARDOUS PLACES
which require reliable and emergency communication

This photograph displays a multi-channel inter-communication system — auxiliary to a standard handset telephone — which can be used for as many as 90 stations.

WRITE FOR INFORMATION ON SYSTEMS TO MEET YOUR REQUIREMENTS

BANK'S MANUFACTURING COMPANY
5019 NORTH WINTHROP AVENUE CHICAGO, ILLINOIS

SUB-CYCLE

The MASTER Ringing Converter

Five Models to Serve You

PRICE

Model "S" Output 20 Watts **$45.00**

NO MOVING PARTS
VIBRATING CONTACTS
ROUTINE MAINTENANCE
RADIO INTERFERENCE

Outputs — 20 or 50 watts
Prices — $45.00 to $113.50

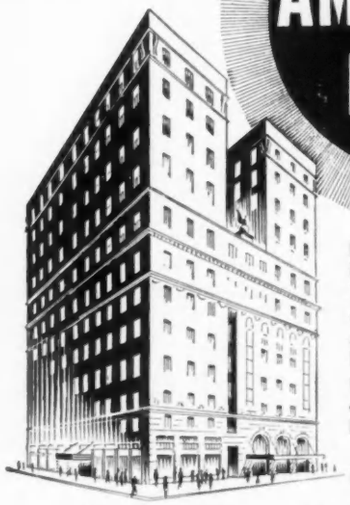
Write for New Booklet

LORAIN PRODUCTS CORPORATION, Lorain, O.

SOLD BY LEADING DISTRIBUTORS
Address Foreign Inquiries to Automatic Electric Sales Co. Ltd., Chicago, Ill.

STOP AT THE RENOWNED

AMERICAN HOTEL



Experienced travelers to St. Louis have solved their hotel problems. The American provides a location convenient to all points of interest and to all transportation, and really fine accommodations at prices that do not involve any sacrifice of comfort or service. Always fine food at the American.

ROOM WITH BATH $1.50

SEVENTH STREET AND MARKET BOULEVARD

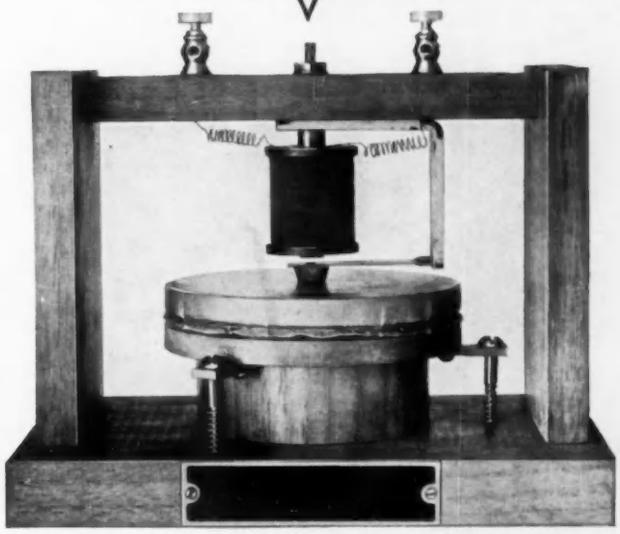
HARRY H O'NEILL, MGR.

GARAGE AND PARKING FACILITIES

MOST CONVENIENT SPOT IN

ST. LOUIS

MR. WATSON, COME HERE I WANT YOU !



We were 6 years old when the *Telephone* was invented

The Company that is now Graybar had been in the electrical business for six years when the telephone was invented.

Today, Graybar provides a complete, convenient source of everything electrical a telephone company needs. Whatever the electrical requirement, you'll find it quickly available from a nearby Graybar warehouse. And behind every product stands Graybar's reputation for dependable, reliable equipment . . . a reputation for quality that goes back seventy years to 1869.

OFFICES IN 83 PRINCIPAL CITIES • EXECUTIVE OFFICES: GRAYBAR BLDG., N.Y.

graduating from Kenyon College where he belonged to Beta Theta Phi Fraternity.

Mr. Woodbury, belonged to Enoch Lodge, Kinsman Chapter, Mt. Vernon Commandery, the Scottish Rite and Alladin Temple of The Shrine, all in Columbus.

In Rochester, he was a member of the Chamber of Commerce where he served as Chairman of the Sales Managers' Club from July, 1933 to January, 1935. Since then he has been a member of the Chamber's Executive Committee. He also belonged to the Rochester Club. Active in religious circles, Mr. Woodbury was a member of the Church of the Epiphany in Rochester, where he served on the governing board of the church.

Besides his wife, Mrs. Abbie Geach Woodbury, Mr. Woodbury leaves a son, John G. Woodbury of Rochester; two daughters, Miss Jean Claire Woodbury and Mrs. Thorkel Scherwin, both of New York; a sister, Miss Margaret Woodbury of Columbus, Ohio and three brothers, William B. of Lake George, Arthur of Long Beach, Calif., and Chester of New York.

Funeral services were held in the Church of the Epiphany, Wednesday, February 1st, with burial Thursday at Granville, Ohio.

Telephone Patents Studied By Anti-Monoply Inquiry

The patents of the Bell System and the policies of its research and manufacturing activities were related to the Temporary National Economic Committee by Dr. Frank B. Jewett, President of the Bell Telephone Laboratories and Vice-President of the American Telephone and Telegraph Company, when the TNEC studied the needs of patent legislation reform in the third week in January—this marked the first entrance into the Anti-Monopoly Inquiry of the telephone industry picture.

The Bell System in its research, development and manufacturing activities has pursued the unique objective of subordinating its functions of supplying equipment and devices to the needs of the telephone service and the users, rather than having a goal of profits in these enterprises, Dr. Jewett declared to the Committee. The Bell Laboratories, due to the natural monopoly of the telephone industry carry on their research program closely intergrated with the needs of telephone service rather than with the idea of developing inventions to sell to the public. The noted Bell System Scientist told the TNEC that the telephone service in the United States today did not just grow and was not built on a foundation of mistakes, but had reached its present high level through the plan of establishing a single supplier of equipment to the operating companies which the "wise men" who founded the Bell System in Boston decided was necessary to bring about steady progress in telephone development.

A high light of Dr. Jewett's testimony was the depiction of the 50,000-hour telephone repeater tube which had meant an annual saving of $10,000,000 to the public but at the same time it had meant a greatly decreased production of tubes by the Western Electric Company. His description of the 50,000-hour tube aroused the curiosity of the TNEC members who plied him with questions whether this long lifed tube could be used in home radio receiving sets. A misconception of the telephone tube arose as a result of this interrogation and Dr. Jewett had to clarify his testimony in a letter to the TNEC during the first week in February to explain that the telephone repeater tube was more expensive and was more carefully engineered and powered than the broadcasting sets. The Bell Telephone Laboratories president cited that the average radio set has a relatively short life of a few years so that the radio set manufacturing industry naturally did not manufacture tubes which would exist beyond the span of the set which housed them. He also told the TNEC that radio tube manufacturers were meeting the requirements of the public in excellent fashion which answered viewpoints of certain TNEC members who indicated that the radio industry should be providing the public with these 50,000-hour tubes.

Western Electric makes the long-life tubes available to Independent Telephone companies, Dr. Jewett informed the TNEC in replying to a question of Federal Trade Commissioner Davis. "For many years repeaters and one and three-channel carrier equipment utilizing such tubes have been available to independent connecting companies by lease from the Bell Associated Companies and, more recently, these equipments have been available by sale from the Western Electric Company.

Reliable

PROTECTED CABLE TERMINALS

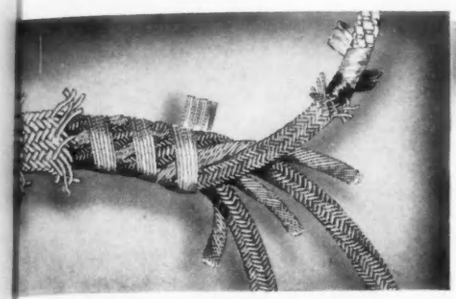
The all metal B-27 is modern and outstanding in design with added assurance of long "terminal life."

Made in three types for three standard cable terminal fuses. Upon request we will send a sample for your inspection without charge.

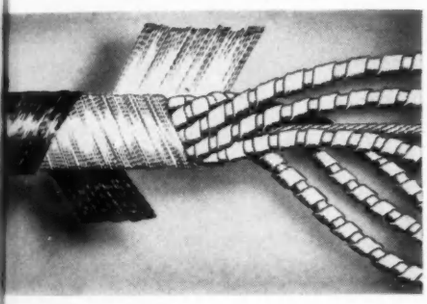
Reliable ELECTRIC COMPANY
OVER 25 YEARS SERVICE TO THE UTILITIES
3 CARROLL AVENUE · CHICAGO ILLINOIS

All you need is 5 MINUTES

. . . TO SEE THE VALUE IN DURATEX CORDS



1 You will see that three conductors make up the switchboard cord illustrated. The stay cord is braided in with the conductors throughout the entire length to insure maximum strength. Further reinforcement is provided with filler threads and two layers of heavy cotton braid.

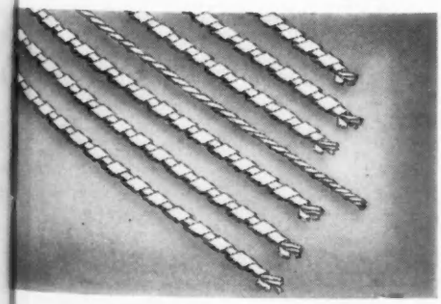


2 Cutting through the durable cotton wrapping, you will find a binding of two servings of silk insulation, moisture-proofed. Inside this binding you will find six conductor strands which are spiraled about a cotton center thread.

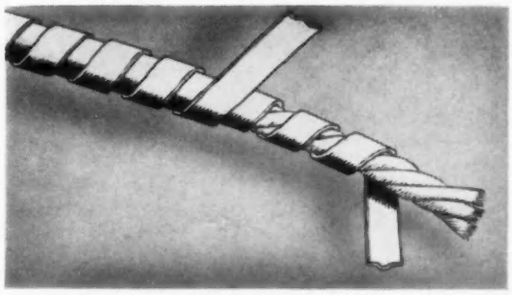
Are you the type who likes to take things apart to see how they run? If you are, just get a sample of Duratex Cord, your jackknife and a magnifying glass. For five minutes you not only will have a lot of fun but will see for yourself just why Stromberg-Carlson Duratex Cords will stand more service than any others and, consequently, why they are the most economical cords you can use.

If you haven't a piece of Duratex Cord, fill in the coupon at the bottom of the page and a sample will be sent you.

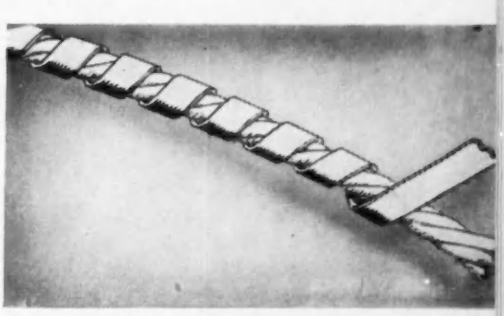
STROMBERG-CARLSON TELEPHONE MANUFACTURING CO
Factory and General Offices: 230 Carlson Road, Rochester, N. Y., U. S. A.
Branch Offices: Chicago, Kansas City, San Francisco, Toronto



3 Then separate these six double-wrapped strands and the three-strand center thread which go to make up a Duratex conductor. Examine the materials carefully. Observe their unusual strength.



4 Examine the way each strand is made up of double-wrapped bronze ribbon of high tensile strength, spiraled about a cotton thread—a construction which assures not only high conductivity but long life.



5 Notice that each strand of a Stromberg-Carlson Duratex conductor consists of a cotton thread which is first wrapped with a bronze alloy ribbon of high tensile strength .001 of an inch in thickness.

Stromberg-Carlson

ERS OF VOICE TRANSMISSION AND VOICE RECEPTION APPARATUS FOR MORE THAN FORTY YEARS

STROMBERG-CARLSON TEL. MFG. CO.
230 Carlson Road, Rochester, N. Y.

Please send me a sample of Duratex Cord free of charge.

Name _____

Company _____

City _____ State _____

LINE and DESK

RAY BLAIN, Member A. I. E. E., Editor

Q. Frequently when buildings are being constructed we are requested to place conduit in the floor so that telephones in the center of rooms may be reached without placing moulding for wires on top of the floor. Will you please advise how this may be accomplished at a reasonable cost?

A. Perhaps the easiest method is to remove all lamps except one in each line circuit. However, this in the opinion of many reduces the operators efficiency. Perhaps the next best method is to use lamp caps of different colors. With this method an operator can answer all lamps in their proper sequence without interfering to any extent with each other. No doubt an "Operators Bar" feature is the most desirable cure for this trouble. When this feature is used the first operator to plug into a line jack gets the call and the second operator receives a tone to indicate that the line has been previously answered by another operator.

Q. We propose to purchase some small rectifiers for use on magneto switchboards for current supply to replace dry cell battery. Is this considered good practice?

A. Special rectifiers are now on the market for this purpose which have proved entirely satisfactory. However, if commercial power fails even momentarily at frequent intervals, dry cell standby battery must be provided. A special relay may be provided to disconnect the rectifier and connect the dry cells to the operators telephone circuit. Dry cells used in this manner will last practically for the shelf life of the battery.

Q. Can you recommend anything that may be used as a warning signal, which will be visible at night for installation on poles along a heavy traveled motor highway?

A. A reflector button type pole marker is the best device we know of for this purpose. These reflectors effectively reflect the light of automobiles to warn drivers and prevent accidents. Marker housings are 8½" x 2" x ¾" in size and constructed of rust proof galvanized iron. Each housing mounts 5 brilliant crystal reflector buttons which are vandal-proof, theft-proof and have precision ground lens to insure uniform reflection. If you maintain a pole line along a busy highway we believe these reflectors will prove worthwhile.

Q. What frequency range is necessary for good transmission over an ordinary telephone circuit?

A. Opinions may differ on this question though we would say that for ordinary voice transmission that the band from 400 to 2800 cycles would prove adequate for good service.

Q. Please advise us how a hydraulic jack may be used for the pushing of pipe under streets and side walks for telephone conduits?

A. We would not recommend the use of an ordinary jack for pipe pushing. A hydraulic pipe pushing machine can be obtained which will satisfactorily meet all of your pipe pushing requirements.

Q. We have a multiple answering jack type switchboard of six positions and have considerable trouble by two operators answering one call at the same time. Is there any method whereby this may be prevented?

A. We assume that you have reference to modern fireproof buildings where ducts are embedded in concrete floors. We are famaliar with two types of duct system designed for this purpose. A square metal duct with openings in the floor at intervals of about two feet. The other is an oval fibre duct in which openings may be cut as desired with special tools. The ducts are always placed in the floors in such locations so as to most conviently reach all desk locations.

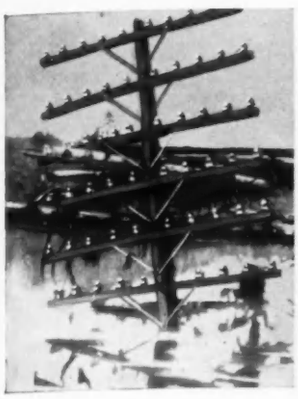
Q. We are having considerable difficulty when soldering connections on main frames when using some of the new types of insulated wire. The heat from the soldering iron seems to be conducted into the wire and the insulation is scorched about one inch from the end. Con you suggest how this trouble may be avoided and at the same time obtain a well soldered connection?

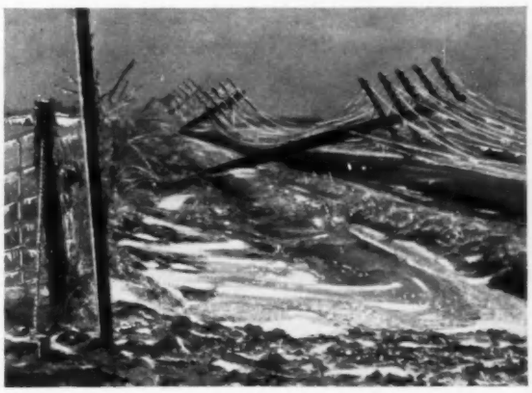
A. There is available a Thermo-Grip type Electric Soldering tool which should be ideal for this purpose. This tool utilizes a small transformer and a carbon arc to produce the heat for the soldered connection. Various type tools can be used with the transformer, such as fork type, pencil point or blunt point. A small clamping tool is also available which will probably prove most desirable for all main frame soldering work. This arrangement works somewhat like a spot welder although in reality it makes a perfectly fluxed soldered connection. The heat application is of such short duration that very little of it is conducted into the wire hence the most delicate insulation is not harmed in the slightest.

Q. We have a toll line of No. 9 iron wire, 100 miles in length which extends from Station A to Station B. Also a circuit 70 miles in length which extends from Station B to C. When we connect these two circiuts together we find it practically impossible to talk from Station A to Station C. Do you think loading would solve our problem or could we make use of the old fashioned mechanical repeaters to advantage?

A. It is difficult to recommend a sure cure for your low transmission unless we know more of the details as to its cause. While copper wire is always to be preferred on a circuit of this length it is believed that you can obtain fairly good transmission if the line is in good condition and proper equipment is used. If the line is noisy, properly spaced transpositions to balance it inductively would probably be a big improvement. If you have some defective line splices they are no doubt responsible for a large part of your losses. If the splices are known to be bad we suggest that you replace them with the new type compression sleeves. We also suggest that you check the insulators and tree clearance on the circuit as this is also a most important factor in a line of this length. We would not ordinarily recommend the loading of open wire although if you have sections of cable in the circiut the loading of it might prove desirable. If you are using old style instruments the transmitters may be packed or defective and old receivers may not be sensative enough for good transmission over this distance. New type substation equipment gives a transmission improvement of 6 to 8 d. b. above that of the old style instruments. If the line conditions are fairly good you can probably solve your low transmission difficulty by installing one or more vacuum tube type voice repeaters. These repeaters may be obtained for battery or 110 volt A. C. operation and require very little attention or maintenance. We suggest that you investigate the possibilities of this type equipment.

Flood! Sleet! Hurricane!





In last September's hurricane, 600,000 telephones were put out of service and 201 communities cut off from the outside world.

"*Call* WESTERN ELECTRIC"

Western Electric replacements in three weeks following the hurricane totaled more than 1200 carloads of materials.

. . . and the Service of Supply is ready

Construction crews were supplied with 25,000 poles, thousands of miles of cable and wire.

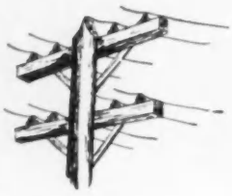
Any day—perhaps tomorrow—in any part of the country, turbulent nature may strike down the telephone lines.

Then hurry calls will pour in to Western Electric for telephones, cable, switchboards, poles and all other supplies.

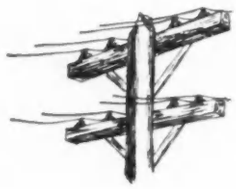
And immediately materials will begin to move by rail, water, highway and air—and factories go on a 24-hour basis. So Western Electric backs up your telephone company in the quick restoration of service.

In such severe tests and in the day-by-day job, this organization meets its responsibility to the Bell System and to you.

Western Electric *. . . made your* **BELL TELEPHONE**



LONG LINES



R. A. Clark, Jr.

Carrier Frequency Attenuation

THE interest in carrier telephone and telegraph operation prompts me to discuss the characteristics of open wire and cable circuits at carrier frequencies. At the present time most carrier systems operate at frequencies between 4000 and 20,000 cycles, however frequencies up to 30,000 cycles have been used extensively and in the future we may expect to employ bands as high as 150,000 cycles.

In order to properly engineer a carrier system and maintain it after installation it is necessary to understand the important transmission and frequency characteristics of the lines used. The transmission loss is a function of the size and kind of wire and to some extent the spacing of the conductors on open wire lines. The carrier attenuation of copper, aluminum and copperweld circuits is about the same in so far as the equivalent resistance is concerned. Iron wire is not very suitable as the hysteresis and eddy current losses introduce an equivalent increase in effective resistance with frequency. However, iron wire can be used and in some cases it is more economical to install carrier repeaters than replace the iron with copper.

CABLE circuits offer a much higher attenuation at carrier frequencies than open wire and are to be avoided as much as possible. However, sections of cable must be used in many instances. We will discuss in this issue the characteristics of open wire circuits and will follow next month with the characteristics of cable.

Figure 1 shows the characteristics of various open wire circuits under dry weather conditions; the curve shows the loss per mile of line. To obtain the total loss for a circuit of any length it is merely necessary to multiply the loss per mile by the length of the line. The curves are based on lines having no taps or intermediate way stations. Taps increase the loss appreciably, often as much as 6 or 8 db. Way stations bridged across the line as on a train dispatching circuit will increase the loss over that shown by about 20% or 30%.

Under wet weather conditions the loss will increase over that shown by as much as 25% to 50%. The higher figure occurs under conditions of heavy snow and sleet which tends to pile up around the insulators and effectively increase the capacity and leakage between wires. It will be seen therefore that a high degree of margin must be maintained in order to permit operation of the carrier systems under all weather conditions. It is good engineering practice to allow at least 50% margin in transmission equivalent to care for all weather conditions. In other words, if a carrier system is designed to operate on a line having an equivalent of 30 db the computed dry weather equivalent should not exceed 20 db.

The impedance characteristics of open wire lines at carrier frequencies ranges from about 600 to 700 ohms. Most carrier apparatus is designed for an impedance of about 650 ohms which is sufficiently close to the characteristics of open wire circuits commonly used that no matching equipment is needed. Even in the case of iron circuits where the

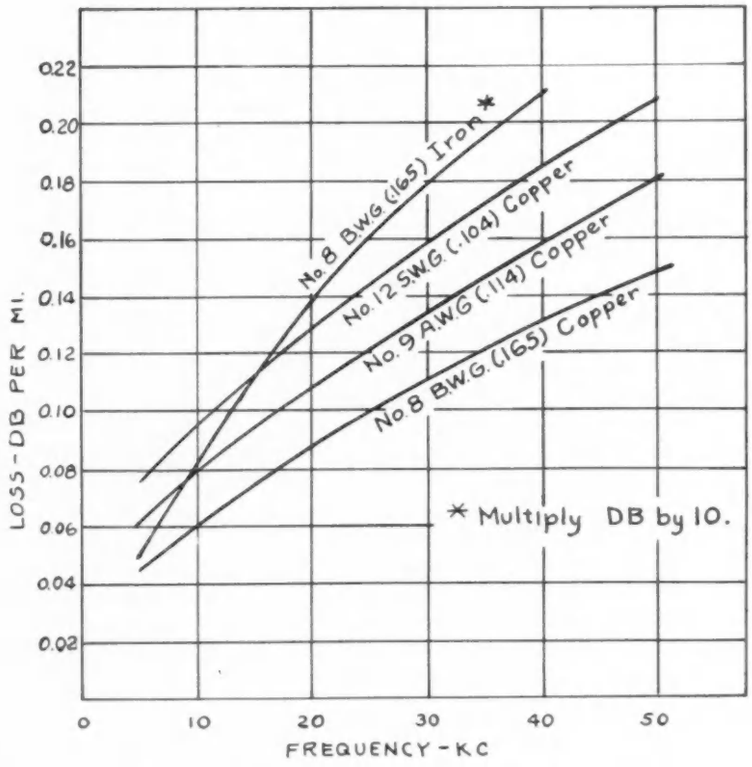


Fig. 1—Attenuation characteristics of open wire lines, dry weather.

WHILE carrier systems are not ordinarily operated on phantom circuits the scheme is entirely practicable and in certain cases may prove advantageous. Where the carrier is operated over lines having a large number of bridging stations such as a train dispatching circuit it is necessary to install filters at each way station. If two such lines are phantomed and the carrier connected on the phantom circuit it is not necessary to install way station filters thus appreciably reducing the cost of the installation. Offsetting this advantage is the increased possibility of failure of the carrier circuit due to line trouble. Assuming a phantom circuit is available the degree of reliability is greatly increased by using a side circuit as contrasted with the phantom. For example, if one side circuit is used failure of one wire of the four will not interrupt the circuit as it can be operated on the good pair. However, if the carrier is on the phantom it will be lost. The attenuation of a phantom circuit at carrier frequencies is approximately the same as on the side circuit, therefore the curves of Fig. 1 may be used in computing attenuation characteristics.

Dry Discs in Telephony

(Continued from page 18)

For two-way trunk lines, sometimes relays are connected at both terminals for signalling purposes. If there are differences between battery and ground potentials in both offices, circulating current will flow, causing false relay operation. Copper oxide units, as shown in Figure 4, will prevent circulating currents, but pass operating current into the relay.

A non-inductive circuit may be connected in multiple to a high inductive relay or magnet, if it is required to have current in both branches simultaneously. When the circuit to them is opened, the collapsing field in the relay generates a current through the non-inductive path. The current in turn tries to maintain the relay operated, so that the relay or magnet will be slow to release. Circulating current will be prevented when the circuit is opened, if a copper oxide unit is connected in the non-inductive branch in such a way that passes the normal current.

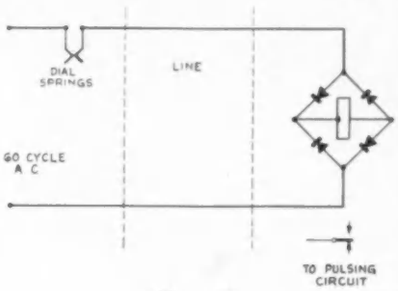


Figure 6

Too numerous to mention are the applications of copper oxide units to prevent "feed back" to relays in complex circuits. A typical example is shown in Figure 5. Relay A in each circuit is energized locally, but the common relay B is operated in series with any of the individual lamps. When, for instance, No. 1 circuit is opened, but No. 2 is not, the potential across relay B will cause current to flow through lamp and relay A in circuit No. 1 which will try to hold relay A operated if its adjustment permits it. A copper oxide unit in series with each lamp would prevent this. The use of copper oxide to stop "feed back" is very convenient, but it often leads to makeshift design, and other solutions should be considered before applying it.

THE second group of applications includes the rectification proper. If alternating current is sent through a copper oxide unit, a pulsating direct current is obtained at its output, its shape depending on the circuit arrangement used. A.C.-D.C. conversion with

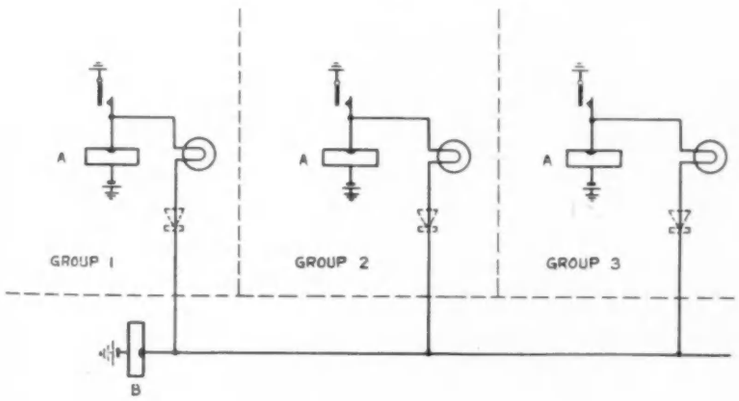


Figure 5

DORSONS
Toll Timer

The economical, efficient means for recording toll calls.

●

DORSONS TOLL TIMERS are now ready for immediate shipment. Write your supplier today and have him ship you one or more. The price is only $22.50. Eliminate all arguments and disputes arising from customers who make toll calls. For further information write:

●

The Dorson Corp.
605 W. Washington Blvd.
CHICAGO, ILLINOIS

AN ANCHOR FOR EVERY JOB • • •
Whether the soil is swamp, rocky, sandy or clay — whether the load is light or heavy — regardless of conditions, there's a Chance Anchor that will do the job easily, economically and permanently.
NEVER-CREEP STEEL TWO-WAY
WEJ-LOCK FOUR-WAY
STEEL FOUR-WAY
WEJ-LOCK THREE-WAY
SEMI-STEEL CONE
THIMBLEYE SCREW
SWAMP SCREW
ROCK
Naturally you can expect better results from the anchor made for the job. No one type will meet all conditions but you can depend on one source of supply for all anchor requirements. Order from this complete line sold by all leading suppliers of telephone equipment.
A·B·CHANCE CO.
CENTRALIA, MISSOURI.

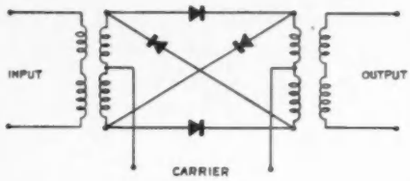


Figure 7

rectifier and its various forms as power supply in telecommunications is well known and has been exhaustively discussed in the literature. Analogously individual D.C. apparatus may be operated by A.C. through small rectifiers. A D.C. relay shunted by a small rectifier will respond to A.C. or D.C. Its performance may be improved by a bridge connection shown in Figure 6. In this circuit the relay receives alternating current dial pulses over the trunk and repeats them to the associated equipment. One half of the rectifier with its reverse resistance shunts the relay in whichever direction the current is flowing; this and few more points incidental to A.C. dialing make the problem rather complex. If the relay is substituted by the power magnet of a step-by-step switch, the latter can be driven from a local A.C. source. For such application it is sometimes found advantageous to connect a large capacity condenser across the coil smoothing out the rectified ripple.

Alternating current measuring instruments belong in the same class of applications. High sensitivity may be obtained by connecting a moving coil milliameter (or microameter) across the output terminals of a rectifier bridge, and will measure the mean value of fluctuating direct current obtained by rectification. Theoretically 1.11 times this mean value is equal to the RMS of the A.C. to be measured, but there are several corrections to be considered: (a) non-linearity of the rectifier for low voltages (about 0.5 volts), (b) reverse current (usually small), (c) voltage drop in the rectifier, (d) ageing, (e) temperature variations, (f) errors due to non-sinusoidal wave form, and (g) frequency errors. Regarding the last item, older instruments showed about 5 percent error at 10,000 cycles due to the shunt capacity of the discs. With newly designed rectifiers using small diameter discs the frequency response is flat up to 100,000 cycles.

THE third group of applications exploits the non-linearity of the copper oxide impedance. The so-called "click absorber varistor" is a typical example consisting of two copper-oxide units of three ¾" discs each (mounted on a common spindle) and both connected in a dry circuit across a telephone receiver in opposite sense to each other. As long as the voltage across the receiver terminals is low, as in the case with speech, the copper oxide impedance is high and does not represent an appreciable attenuation. When the voltage rises to a disturbing value, the rectifier impedance correspondingly decreases (figure 3) and at a high voltage practically short circuits the receiver. It is apparent that the unidirectional conductivity has not been utilized in this case, on the contrary, by the two multiple, opposing units its

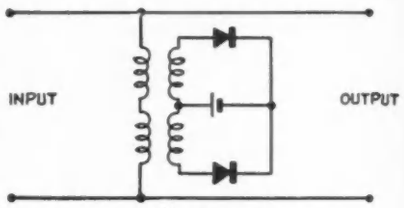


Figure 8

polarizing effect has been destroyed, and so any type of non-linear resistance of suitable characteristic could serve the same purpose.

● The same non-linear feature is used in modulator and demodulator bridges for carrier current telephony (Figure 7); in "negative feed back" type voice repeaters, echo suppressors, frequency multipliers, harmonic compensators, trigger circuits and numerous other applications. Figure 8 shows an amplitude limiter arrangement. Due to the D.C. bias the copper oxide units are operating on a certain prescribed point of the characteristic. A.C. line voltage up to certain value can pass the limiter without attenuation, but exceeding this the copper oxide impedance rapidly decreases, and above certain line voltage values, short circuits the line for all practical purposes.

(END)

Movie to Depict The Life of Bell

Charles Coburn, outstanding actor who made such a hit in "Of Human Hearts" and other films, has been signed by 20th Century-Fox for one of the most important roles in "The Life of Alexander Graham Bell," which will co-star Loretta Young and Don Ameche.

The historical film of the noted inventor's life has been scheduled by Darryl F. Zanuck, studio production chief, as one of the most important pictures on the new year's program.

Ha Ha Ha Ha These TICKLED Us!

Louis Pitcher, executive vice-president of the United States Independent Telephone Association, sends us one on the chocolate colored parson who got under the skins of his congregation. He writes.

"Folks," said the colored minister, "the subject of the discourse this afternoon am 'Liars.' How many of you have read the Sixty-ninth chapter of Matthew?" Every hand was raised. "Dat's right, you is jes' de folks I wants t' talk to. There ain't no Sixty-ninth chapter of Matthew."

▲ ▲ ▲

Sam Shutt, general manager of the Texas Telephone company, Sherman, Texas, tells us about an incident that actually happened in one of the exchanges under his control. Says Sam:

"We had a very unusual thing to happen at our Aransas Pass exchange a few weeks ago. Aransas Pass is in an oil field and there are pipe lines running through the town, going to the loading racks at Harbor Island on the gulf. Some workmen, while repairing one of these pipe lines with an acetylene torch, made a hole in a large pipe and as the crude oil was under high pressure a stream of fire went into the air when the oil became ignited from the torch. It happened that we had a 50 pair cable directly over the pipe line, so you can imagine what happened to the cable. About 25 or 30 feet of it was melted entirely away and it was damaged for a considerable distance each direction from the blaze. Fortunately we were able to restore service the same day."

▼ ▼ ▼

Here's another from the pen of J. E. Stuart, vice president of the Two States Telephone company with headquarters at Texarkana. Stuart tells about Geo. B. Butler's visit to Chicago. Butler is secretary of the Texas Telephone Association. Here's the story:

"George ran out of money at a conference in Chicago at the end of a taxi ride and the hotel in which he was registered charged it to his account. Several days later in checking out, he found an item on his bill which read: 'May 25, 1938—POOT—$1.50.' Forgetting about the taxi ride, he curiously inquired of the cashier and found out the charge was 'Put Out on Taxi.' No joke either."

You remember him — Bill Qualls — who used to roam around the country selling Monarch telephones and switchboards. Well, he's still in the land of the living, resides at South Bend, Ind., and has charge of the electrical department of that thriving city. He chimes in with the following:

"An old maid wrote the telephone company that she was shocked by the language used loudly by workmen who were repairing the lines near her home. The manager asked for a report on the matter and his foreman sent in the following: 'Me and Joe Brady was on the job. I was up on the pole and happened to drop some hot metal on Joe; it ran down his neck. Joe said 'you really must be more careful, Bill.' "

▼ ▼ ▼

Lon J. Darley, manager of the Magnolia Telephone company, Jackson, Miss., tells of a conversation between two of the children of his neighborhood. It runs like this:

"My mother is so smart that she can talk at any time on almost any subject," says little Johnny, proud son of a prominent civic leader. "Huh, that's nothing," rejoined the neighboring boy. "My mother can talk all the time without a subject."

▼ ▼ ▼

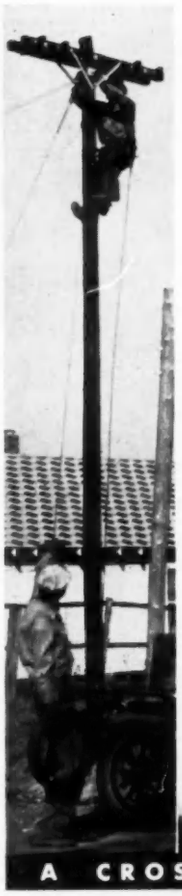
Tom Murray, editor of Automatic World, Fort Worth, Texas, submits this one:

"Yes," said Mrs. Neighbor, "our furniture is very antique. This bed, for instance, goes back to Louis the XIV." "Oh well, don't feel so bad about it," replies Mrs. Knox, "our whole living room outfit goes back to Cohen on the 30th."

▼ ▼ ▼

Another from our old friend, P. Kerr Higgins of St. Louis:

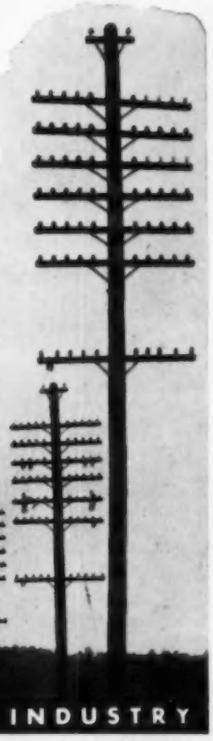
"You are suffering from indigestion," says Dr. Tellem. "What you need is a glass of hot water every morning." To which the star boarder-patient replied, "I have been doing that for months, doctor, only my landlady calls it coffee."



Heavy Duty or Rural, it's
"DIXIE"
DENSE LONGLEAF
POLES

Cross-country or rural, "DIXIE" all dense longleaf Poles meet every requirement for strength, straightness and resistance to weather, decay and insects. Properly seasoned. Correctly graded. Available untreated or pressure-treated (Creosoted or "Wolmanized"). Large stocks of all standard sizes for prompt shipment. Let us quote on your requirements.

JACKSON LUMBER COMPANY
LOCKHART, ALABAMA



A CROSSETT WATZEK GATES INDUSTRY

CABLEMEN'S

UNBREAKABLE THERMOMETER

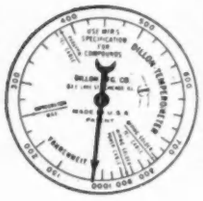
A testing instrument embracing utility, stability, beauty and accuracy, for all purposes

Calibrated For Fahrenheit or Centigrade

Due to the scientific value of the DILLON TEMPEROMETER in determining temperatures, thereby increasing cablemen's efficiency in turning out dependable work, they are being placed in their kits as standard equipment, by the larger operating companies.

Price $6.00 F.O.B Chicago

Order through your Jobber, or direct to,



REGISTERS CORRECT TEMPERATURES OF—

- ★ Paraffine
- ★ Impregnation Wax
- ★ Compounds
- ★ Wiping Solder
- ★ Cable Damming Waxes.

DILLON MANUFACTURING COMPANY

63 East Lake Street **Chicago, Illinois**

SALES CONTESTS •

Pin this ad to your letterhead and get a copy of "How to Run Better Sales Contests" by Zenn Kaufman.

The book is sent on approval for a 10-day examination. Pay $3.50 if you keep it.

BUSINESS BOOK SERVICE
25 West 45th Street - New York

TELERING

Only ONE Contact!
Price $44.00
F. O. B. factory

For better and cheaper ringing.
No Radio Interference
30-day free trial
TELKOR, Inc.
ELYRIA, OHIO
(See our space in next month's issue)

WB — QUALITY WIRE And CORD Since 1900

Distributed and Guaranteed by Graybar Electric Company

The WHITNEY BLAKE CO.
NEW HAVEN CONN.

Bind Your 1938 Copies
of
TELEPHONE ENGINEER
$1.75

Forward Copies — We Will Bind and Return

Minnesota Association Views Wages-Hours Law

DIGGING into the Wages-Hours Law and its effect on its members, the Minnesota Telephone Association started the year's schedule of state conventions off on a subject of much importance at St. Paul, Minnesota, when convening its 30th annual convention on January 24-26. Tempered with other subjects plus entertainment, exhibits, etc., the Wages-Hours subject receive by far the most attention at the meeting.

Selected as president for the current year was W. A. Eckles of Blue Earth, a pioneer who has been in the telephone business for 38 years. H. F. Leuders of Norwood, was selected as vice president and J. C. Crowley, Jr., one of the most popular of state association secretaries was again rewarded by re-election as secretary treasurer. Directors re-elected were: Charles Cashel, Worthington; Warren B. Clay, Hutchinson; P. A. Glaeser, Waconia; H. P. Sentman, Fairmont, and Irving Todd, Hastings.

Addresses made were by retiring president Jame P. Keane, Pine Island, who discussed the association year and the problems faced and yet to be faced. A feature was produced by Secretary Crowley in presenting four women from different companies in a discussion titled "Results of 1938 Compared with 1937."

SERVICE improvement demonstration was made by representatives of the Tri State Tel. & Tel. Company. E. S. True spoke on the subject "Corrosion of Buried Cable and its Prevention." His address was based on a treatise that was started in the January issue of TELEPHONE ENGINEER.

"Cooperation Between Telephone Companies and REA Projects" was presented by A. N. Fancher, St. Paul; supervisor of Telephones Minnesota Railroad & Warehouse Commission. Other subjects presented included papers by W. F. Rosenwald, St. Paul; Irving Todd, Hastings; J. O. Christianson, St. Paul; Louis Pitcher, executive vice president of the U. S. Independent Telephone Association on the subject "Fair Labor Standards Act of 1938"; F. R. Kappel, Omaha, Nebr. and Jay Greaves, of Glencoe.

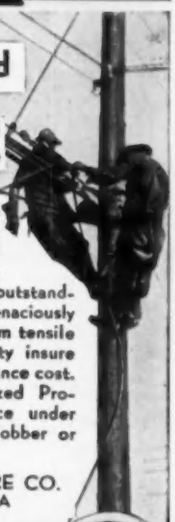
Resolutions were ordered and adopted relative to the National Labor Relations Act of 1938 and the hardship its imposition will cause to small companies. Copies were ordered sent to Minnesota Senators and Congressmen as well as the Administrator of the Act.

J. C. Crowley, Jr., long-time secretary-treasurer of the Minnesota Telephone Association was re-elected at the convention last month.

Crapo GALVANIZED PRODUCTS

Steel Strand

Telephone and Telegraph Wire



Where strains and stresses are heaviest, where corrosion takes its greatest toll, Crapo Galvanized Steel Strand and Telephone Wire constantly are proving their outstanding superiority. The heavy, tenaciously bonded zinc coating, maximum tensile strength and correct ductility insure longer life and lower maintenance cost. Insist upon Crapo Galvanized Products for better performance under all conditions! Ask your Jobber or write direct!

INDIANA STEEL & WIRE CO.
MUNCIE, • INDIANA

Crapo Galvanized Strand and Telephone Wire can be obtained readily in all standard grades and sizes.

KEARNEY

Cooperates with You to Produce Even Better

TELEPHONE ACCESSORIES

2, 3, and 4-way Expansion Anchors—Screw Anchors for various soil conditions — for BETTER ANCHORING

Solderless Wire Con-Nec-Tites, Lap-Tites and Kum-Press Sleeves — for BETTER CONNECTIONS

Full-Vu Guy Guards, Guy Wire Clips and Kearney Strand Bands — for BETTER GUYING

Fit-Rite Wire Holders, Snub-R-Grips, Pole and House Hooks — for BETTER SERVICE

Watch Kearney Ads — for PRODUCTS

THERE are many time- and money-saving telephone line accessories produced by Kearney . . . But there may be special accessories which you need.

Kearney Designing Engineers from both the telephone and power fields are always ready to cooperate with you to produce even better products for field use.

Submit your problem to Kearney engineers.

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

DISTRIBUTED THROUGH JOBBERS

TELEPHONE ACCESSORIES

Texas Convention March 21-23

The Texas Telephone Association mapped a program for its convention March 21-23 in Dallas at a directors meeting in the Baker Hotel recently.

The convention will meet in the Baker. Oscar Burton of Tyler, president, said after the meeting he expects a peak attendance of 400.

Twenty-five men representing various telephone companies of the state attended the meeting.

REA to Promote Rural Phone Lines?

The state rural electrification authority of North Carolina discussed during December the possibility of a survey to determine whether there is a demand for a rural telephone promotion program in North Carolina similar to the electrification work already engaged in by the agency.

Dudley Bagley, authority chairman, said the 1939 general assembly might be asked to provide an appropriation for an engineer to make a state-wide study. If a demand is found for a rural telephone program, he said, the 1941 general assembly be asked to make an appropriation for it.

HELP: MISSING

An unusual demand for our July 1938 issue has completely depleted our files. If you will forward us copies of July 1938, your subscription will be extended 4 months. Attach your name and address and forward copy immediately.

Independent Pioneers Offer Employment Assistance

Employment Assistance forms are now being distributed by J. K. Johnston, sec-treas. of the Independent Pioneer Telephone Association, from headquarters in 632 Lemcke Bldg., Indianapolis.

This new feature was discussed at the last annual meeting and resulted in the Executive Committee authorizing Secretary Johnston to endeavor to assist worthy unemployed telephone men and women in securing a position wherever possible.

If you are unemployed or know of any worthy telephone men or women you will be assisting in suggesting they communicate with Mr. Johnston at Indianapolis headquarters immediately.

F. E. Behm Elevated by Lincoln Tel. & Tel.

Announcement was made recently by F. H. Woods, president of The Lincoln Telephone and Telegraph Company, of the appointment of F. E. Behm as General Plant Superintendent, effective January 1, 1939. Mr. Behm succeeded Mr. Mark T. Caster, who retires in accordance with the Company's plans for pensions and retirements.

Mr. Caster retires after 46 years of service in the telephone business, 34 years of which have been with the Lincoln Telephone and Telegraph Company. In the early years, Mr. Caster served as Construction Foreman, Cable Splicer, Construction Superintendent, and finally as General Plant Superintendent, which position he has occupied for 30 years.

His many years of active service have given him a very wide acquaintance with telephone men throughout the entire country. He has served on many committees in state organizations and of national associations, having helped prepare the Standard Hand Books containing rules for construction of wire lines at railroad crossings now in effect in Nebraska.

During the past ten years he has been actively identified with safety work, both in the State organization and on the National Council. Although he retires from active service as General Plant Superintendent, Mr. Caster will continue to devote a part of his time to the safety program of The Lincoln Telephone and Telegraph Company.

Stork, Marooned in Snow, Delivers a Baby by Phone

According to the Associated Press Dr. R. M. Kilgard of Watertown became caught in a snowdrift on Feb. 10, while attempting to reach the home of Leif Nelson at Florence, where a baby was expected. The doctor returned to town and reached the Nelson home by Telephone. Then, with Mrs. Lyle Thorson, graduate nurse, carrying out his instructions, the baby was born shortly afterward.

A T & T Doubles January Installations

The American Telephone and Telegraph company today reported a January, 1939, gain of 65,000 telephones in service in principal telephone subsidiaries included in the Bell system. The gain was 31,400 in January, 1938.

When You Order Unprotected Cable Terminals, Specify

COOK XB

— the terminal which so many telephone engineers all over the world use exclusively for its long life, and dependable service.

- Tight Fitting Hood.
- Exclusive Weather Guard for drop openings.
- Strong, Moisture-proof cable connection.
- Protection against weather, condensation, dirt and insects.
- Light, Compact, fits close to pole or wall.
- Reversible, cable out of either top or bottom.
- Made in 6, 11, 16 and 26 pair sizes.

TERMINAL AND PROTECTION EQUIPMENT

COOK

COOK ELECTRIC CO., 2700 SOUTHPORT AVE., CHICAGO

Kingfisher, Okla. Installs New Switchboard

By R. L. Thomas, Representative
Kellogg Switchboard & Supply Company

Operators working at the new Kellogg 12-1600 Masterbuilt Switchboard recently installed at Kingfisher, Oklahoma.

WITH THE completion of the installation of a 3-position Kellogg Masterbuilt switchboard, Kingfisher, Oklahoma, subscribers will now have a modern telephone system. The installation of this new Kellogg central office equipment marks the culmination of a complete rehabilitation program including a new outside plant and rebuilding the exchange building of the Western Light and Telephone Company's Kingfisher Exchange.

Kingfisher became a city almost overnight in 1889 when the Cheyenne and Arapaho strip of free Government land was opened to homesteaders. Its first exchange was opened just before the run. In 1902 a Kellogg magneto board was installed and their equipment is still their choice. With a present population of only 3,000 the Kingfisher exchange has 1150 stations—nearly an all time peak. And the city is still growing rapidly. All business buildings are filled and new space is in demand. The future looks bright indeed.

Mr. F. M. Browne, Vice-President and General Manager, and Mr. Endsley Jones, Division Superintendent, are to be congratulated on the complete rejuvenation of their exchange and the smooth, trouble-free installation and cut-over. Unquestionably, they have done a good deal to insure the future progress and expansion of Kingfisher with the installation of this modern telephone system.

DIG FOR IT!

OUT in your warehouse you probably have a lot of used telephone parts than can be used in manufacturing the new telephones you need. They are worth plenty of money if you just dig them out and use them.

How to Cash It!

To get full value out of these parts send them to Suttle for remanufacturing. To make them pay you must get telephone equipment that will toe the mark on performance, and thrill the public on looks.

You can rely on Suttle to provide equipment with these qualities. Suttle Remanufacturing Service always costs a little more because it's worth much more.

SUTTLE EQUIPMENT COMPANY
LAWRENCEVILLE, ILLINOIS

A NEW

4 FREQUENCY MOTOR GENERATOR

This Machine has no moving conductors.

Requires neither brushes or collector rings.

Low cost maintenance.

Low current consumption.

Output 25 watts.

Can be furnished for A.C. or D.C. drive or both.

Can be equipped with tone, and machine ringing interrupters.

For Complete Information, Write

THE HOLTZER-CABOT ELECTRIC CO.

125 Amory St.
BOSTON, MASS.

6161 So. State St.
CHICAGO, ILL.

The Clearing House

For the convenience of readers of Telephone Engineer

Bell Laboratories Increase Capital

Albany, New York.—Bell Telephone Laboratories, Inc., during the past week filed with the Secretary of State an increase in capital from $100,000 to $5,000,000.

TELEPHONE DIRECTORY
LOOMIS ADVERTISING CO.
TELEPHONE DIRECTORY ADVERTISING
A SALES ORGANIZATION
Exclusively....
That Has Never Failed to Produce More Net Revenue for Telephone Companies Served, All Costs Considered.
IF INTERESTED in more net telephone directory revenue write or call at our expense.
LOOMIS ADVERTISING CO.
Telephone Bldg., Kansas City, Mo.
Citizens Trust Bldg., Ft. Wayne, Ind.
135 So. Second St., Philadelphia, Pa.

I. T. & T. Units to Sell Tools

Manufacturing and sales companies of the International Telephone & Telegraph Corp., abroad have entered the field of electrical portable tools as a result of a long-term contract arranged between International Standard Electric Corp. and the Cincinnati Electrical Tool Co., of Cincinnati, Ohio.

Louis A. De Berard Dies

Louis A. De Berard, 63, formerly connected with the Automatic Electric Company, died in his home at 575 Drexel avenue in Glencoe, (Ill.) after an illness of several months. For the last two years Mr. De Berard had been engaged in the manufacture of oil burners.

Ligonier (Ind.) Orders Leich C.B. Switchboard

The Ligonier Telephone Company of Ligonier, Indiana, has signed a contract for delivery of a two-position Leich common battery switchboard this month. The new board will be of the universal convertible type and will be wired and equipped for 440 universal line circuits and 20 lamp ended rural and toll circuits. Each position will be provided with 17 universal cord circuits providing a 2-party automatic ringing on local lines and manual code ringing on rural lines. Equipment accessories to be provided include a calculagraph, wire chiefs test unit and power board.

Mr. Harry Inks, one of the pioneer independent telephone men in Indiana has long directed the Ligonier and has been ably assisted in recent years by his son, Burl Inks. All negotiations leading to the purchase of the switchboard which included a visit to an exchange having a similar Leich switchboard, were conducted by Carl M. Bowling, Leich's Indiana representative.

W. R. Swoish Joins Roller-Smith

Selected as Sales Manager of Roller-Smith Company, W. R. Swoish, formerly with Westinghouse, was elevated to his new position on January 1.

S. E. Wright Chosen by National Tel. Supply

Mr. Fred Auxer, president of The National Telephone Supply Company, has just appointed Mr. S. E. Wright as General Sales Manager for the National Telephone Supply Company, Cleveland. Mr. Wright takes up the work supervised by Mr. C. C. Mahan previous to his death.

S. E. Wright

Mr. Wright comes to The National Telephone Supply Company well equipped by training and experience to supervise the merchandising of National line materials. Previous to his taking this new position Mr. Wright was Directing Head of the Power Sales Department at the Ohio Public Service Company and was located at Massillon, Ohio.

Neil C. Hurley, Jr. Elected

Mr. Neil C. Hurley, Jr., was elected a Vice President of the Independent Pneumatic Tool Company at a special meeting of the board of directors today. Mr. Hurley has been secretary of the company for the past four years.

He joined the company in 1932 upon graduation from the University of

Poles

Carney
CEDAR POLES
Plain or Butt Treated
B. J. CARNEY & CO.
100 No. 7th St. Minneapolis

Finished Cedar Poles
VALENTINE CLARK CORPORATION
St. Paul, Minn.

WILL BUY TELEPHONE EXCHANGE in Middle or Western State from 200 to 500 stations. Want a small exchange, but not too small. Will want to own and manage exchange myself. Answer W. H. M. c/o TELEPHONE ENGINEER.

The Clearing House

For the convenience of readers of Telephone Engineer

Telephone Directories

Telephone Directory
ADVERTISING
Write or telephone for proposition
L.M.BERRY & CO.
Call L D 16 - Telephone Bldg. Dayton O

Telephone Engineers

J. G. WRAY & CO.
Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies
105 West Adams Street
CHICAGO

J. W. WOPAT
CONSULTING ENGINEER
Telephone Engineering — Construction Supervision — Appraisals — Financial — Rate Investigations
303 East Berry Street
Fort Wayne, Indiana

RECONSTRUCTED EQUIPMENT

Genuine Kellogg No. 2309 4-bar 1000 ohm ringer inside connection desk set signal sets @	$6.25
Genuine Kellogg Latest type No. 2809 4-bar 1900 ohm ringer Compacts @	9.25
Stromberg Carlson Heavy duty 5-bar Gen. with Mtg. Screws & Crank @	2.75
Stromberg Carlson No. 27 Latest type Rec. with New shell & Cord @	1.15
Western Elec. 1000 ohm self contained ringers with gongs @	1.65
Western Elec. No. 250 Transmitter with back & Mouthpiece @	1.00
Leich or Monarch L or C. Transmitter with back & Mouthpiece @	.90
Kellogg No. 18 Phantom Coil @	5.00
Western Elec. No. 46 Central Battery Ind. Coils @ 50c No. 20 @	.35
Kellogg No. 115 Grabaphone complete less signal set @	4.50
Western Elec. No. 20 desk set with No. 315 3-bar 1000-1600 or 2500 ohm ringer inside connection signal set $10.00 — 4-bar $10.75 — 5-bar @	11.50
Kellogg No. 84 desk set with New Cabinet 3-bar 1000-1600 or 2500 ohm ringer inside connection signal set $9.75 — 4-bar fi10.50 — 5-bar @	11.25
Monarch No. 33 desk set with 3-bar 1000-1600 or 2500 ohm ringer inside connection signal set @	7.85
L. M. Ericsson Slip type Receivers with repolished shell & New Cord @	.75
Leich Elec. Slip type Receiver with New Shell & Cord @	1.10
Stromberg Carlson Cordless P. B. X. with 10 local lamp lines with line relays & 3 Trunks complete with Opr. desk stand @	95.00

REBUILT ELECTRIC EQUIPMENT CO.
Not Inc.
1934 WEST 21ST ST.
CHICAGO, ILL.

Notre Dame and has been active in the direction of sales for the company's electric tool division.

New Bulletin Available

Bulletin No. 690 describing Telephone Transmission Testing Equipment has just been completed by the Shallcross Mfg. Company. Complete details including theory is explained fully. This bulletin is available at no cost.

A Transtester (Decibel Meter) and Tone Generator (1000 Cycle Oscillator) has been developed to provide a convenient yet inexpensive method of measuring transmission loss in lines, switchboard circuits, apparatus and other equipment. Wire chiefs will be greatly interested in this testing equipment that allows many diversified uses.

The Bulletin may be obtained from the company at Collingdale, Pa., or by addressing the editor of TELEPHONE ENGINEER.

Strowger Equipment Portugal Specifies

London, England:—Automatic Telephone & Electric Company, Limited, has announced the signing of a long term contract with the Portugese government for the conversion of that country's entire telephone facilities to automatic operation on an "ATM" Strowger basis.

Terms of the agreement provide for fully automatic main exchanges with a large number of smaller semi-automatic sub-exchanges in each area. Equipment to be used will be Strowger type, as standardized by the British Post Office. Initially, the conversion will be made in the Coimbra and the Braga areas, with installations following progressively in other areas until telephone facilities of the whole of Portugal are under automatic operation.

It is regarded as a tribute also to the inventive genius of the Strowger staff of Automatic Electric Company, Chicago, who originated the Strowger idea, gave it practical perfection, and through the cooperation of licensee companies throughout the world brought it to the stage of international acceptance.

Telephone Repair Co.
SPECIALISTS IN
REBUILDING AND REPAIRING
TRANSMITTERS
Grounded Transmitters Metalicized

COMMON BATTERY ENCLOSED GONG TELEPHONES. Wall or Desk sets rebuilt from MAGNETO TELEPHONES.

Stromberg Magneto Switchboard, 150 line capacity, 20 lines equipped, in good condition, "as is"	$ 75.00
Rebuilt Switchboards, guaranteed A-1 condition. Western Electric magneto 1200 type, 105 line capacity, 85 lines equipped	225.00
Western Electric magneto 1800 type, 30 line floor type	135.00
Kellogg C.B. cordless P.B.X. 8 lines, 2 trunks	85.00
Main distributing frames complete with distributing blocks and arresters, Cook, per line	.50
Western Electric, per line	.65

A Post Card Brings Full Information.

Telephone Repair Co.
Daniel H. McNulty, Manager
Rogers Park Station Chicago

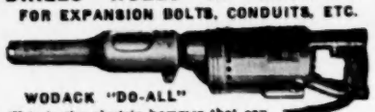
CENTRAL OFFICE PROTECTION
W.E. Co. No. 1168-1169
W.E. Co. No. 1268-1269
W.E. Co. No. 1078-A

PROTECTOR GROUPS
W.E. Co. No. 1435-U
W.E. Co. No. 1435-T
W.E. Co. No. 1435-R

◆

Buckeye Telephone & Supply Company
COLUMBUS, OHIO

DRILLS HOLES IN CONCRETE
FOR EXPANSION BOLTS, CONDUITS, ETC.



WODACK "DO-ALL"
This is the electric hammer that can be changed to a drill for metal and wood. Two sizes. Ask for prices.
Wodack Elec. Tool Corp. 4637 W. Huron St. CHICAGO, ILL.

PUTTING RARE GASES TO WORK

THE VINCENT RARE GAS RELAY
On rural party lines cuts out inductive interference, improves transmission; used with either coded or harmonic bells. EASY to install.

RARE GAS ARRESTERS

Avoid interruptions to service and provide full protection. Keep your lines clear and reduce maintenance expense. Interchangeable with other types.

TEST-O-LITE
Handiest electrical tester made; quickly locates trouble in electric circuits, fuses, cut-outs, motors, radios, etc. 1,001 uses for electricians. Tests any voltage 110 to 550; tells A.C. from D.C. Fountain-pen size; with pocket clip. Lifetime guarantee.

L. S. BRACH Mfg. Corp.
NEWARK, N. J. - Estab. 1906
Oldest Makers of Rare Gas Devices

"UNIQUE" SPLICER'S TOOLS

NO. 3 TORCH
A fine ***cold weather*** torch—9" fuel travel and long windshield give it unusual resistance to wind and cold. Channel plugs, jet block and cleaning needle easily removable for cleaning. All-welded steel tank with bottom funnel filler.

NO. 53 GASOLINE **FURNACE** NO. 55 KEROSENE

This fast-heating heavy-duty furnace will speed up the work of your splicers—will give you more and better service because of the Figure "8" Generator coil and orifice scraper.
Welded steel tank with powerful pump. Furnace takes 8" (50 lb.) pot.
Try either one For 30 Days!

Folding Shields - Solder Pots - Ladles
UNIQUE MANUFACTURING CO., INC.
221 W. Walton St. Chicago, Ill.

Index to Advertisements

A
American Steel & Wire Co. —
American Tel. & Tel. Co. 8-9
Automatic Electric Co. 22-23
Anaconda Wire & Cable —

B
Banks Mfg. Company 26
Bartlett Mfg. Co. —
Bell Lumber & Pole Co. —
Berry, L. M. 40
Bethlehem Steel Co. —
Blackburn Products, Jasper —
Brach, L. S. Mfg. Co. 42
Brown Wood Preserving Co. —
Buckeye Telephone Supply Co. 41

C
Calculagraph Co. 6
Carney & Company 40
Chance Co., A. B. 34
Churchill Cabinet Co. —
Clayton & Lambert Mfg. Co. —
Coffing Hoist Co. —
Columbia Steel Co. —
Communication Equipment & Engineering Co. —
Cook Electric Co. 38
Copperweld Steel Co. 2

D
Davey Tree Expert Co. —
Dillon Mfg. Co. 36
Dorson Corporation 33

E
Electric Products Co. —
Electric Specialty Mfg. Co. —
Electric Storage Battery Co., The 11

F
Fansteel Metallurgical Corp'n —
Forged Steel Products Co. —
Four Wheel Drive Auto Co. —

G
Gardiner Metal Co. —
General Time Service —
Graybar Electric Co. 27

H
Habirshaw Div., Phelps Dodge Copper Products Corp. —
Holtzer Cabot Electric Co. 39
Hubbard & Co. —

I
Indiana Steel & Wire Co. 37

J
Jackson Lumber Co. 35

K
Kaufman, Zenn 36
Kearney Corp., Jas. R. 37
Kellogg Switchboard & Supply Co. 4-5
Klein Mathias & Sons —

L
Leich Sales Corp. 3
Lenz Electric Mfg. Co. 43
Loomis Advertising Co. 40
Lorain Products Corp. 27

M
Matthews Corp., W. N. —
Michigan Pole & Tie Co. —

N
National Carbon Co. 12
National Lead Co. —
National Telephone Supply Co. 43
North Electric Mfg. Co. 44

O
Oliver Iron & Steel Corp. —
Owens-Illinois Glass Co. —

P
Paine Company, The —
Phelps Dodge Copper Prod Co. —
Phillips Electric Works, Ltd. —

R
Ray-O-Vac. Co. —
Raytheon Mfg. Co. 25
Ready Mfg. Co. —
Rebuilt Electric Equipment 41
Reliable Electric Co. 23

S
Shallcross Mfg. Co. —
Siemens Bros. & Co., Ltd. —
South Bend Lathe Works —
Stromberg-Carlson Tel. Mfg. Co. 7-29
Suttle Equipment Co. 39

T
Telkor, Inc. 36
Telephone Repair Co. 41

U
Unique Mfg. Co. 42
Union Carbide & Carbon Co. 12
U. S. Steel Corp. —
U. S. Independent Tel. Assn. —

V
Valentine & Clark Corp. 40

W
Western Electric Co. 31
Whitney Blake Co. 36
Williams, Geo. E. —
Wodack Electric Tool Co. 42
Wood Preserving Corp. —
Wopat, J. W. 40
Wray, J. G., & Co. 40